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ABSTRACT

The 1982 Search for Excellence in Science Education project has identified 10 exemplary programs in biology. Descriptions of the programs and the criteria used in their selection are presented. Chapter 1 discusses the desired state in biology education, examining the goals of biology education and how these goals relate to biology curriculum and instruction. These goals, which focus on personal needs, societal issues, fundamental knowledge, and careers, were among the criteria used for defining excellence in these programs. Chapters 2 to 11 provide descriptions of the exemplary programs (including programs in limnology, marine biology, ecology, and health). The descriptions include: information about the setting of the program (community location, size, specific features, school science, and organization); nature of the program (grade, level, class sizes, curriculum outline, learning activities, evaluation techniques); origin of the program; and what factors contribute to the program's success and what is needed to keep it going. Chapter 12 synthesizes the ideas found in these programs and offers generalizations and recommendations related to excellence in biology programs. For example, excellent programs were found to consider values and ethics related to personal decisions and social policies and to focus on social issues and relations between ecology and the community. (JN)

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# FOCUS ON EXCELLENCE

Volume 1   Number 3

## BIOLOGY

Edited by

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and
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The 1982 **Focus On Excellence** series includes separate monographs on:

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## TABLE OF CONTENTS

Chapter Page

Prologue **Seeking Excellent Biology Programs**

John E. Penick
University of Iowa . . . . . . . . . . . . . . . . . . 1

1. **A New View for Biology Education**

Rodger W. Bybee
University of Minnesota . . . . . . . . . . . . . . 4

2. **Lindlearn Biology**

Joseph Maurer
Lindenhurst High School . . . . . . . . . . . . . . . . 12

3. **Modified Team Approach to Teaching Biology**

Raylene Owen, Sally Swartz, Pat Huwa and Russ Doren
Cherry Creek High School . . . . . . . . . . . . . . . 25

4. **Limnology**

Edwin Vetter
Kathleen Senior High School . . . . . . . . . . . . . 38

5. **Summer Marine Biology**

Phoebe Miller
Rockledge High School . . . . . . . . . . . . . . . . 46

6. **Stones and Bones**

Sid Sitkoff and Matt Matsumoto
Los Angeles Unified School District . . . . . . . . . 55

7. **Biology I and II**

Bud Ellis
Addison High School . . . . . . . . . . . . . . . . . 65

8. **Drey Land Ecology Study**

Bruce Westling
John Burroughs School. . . . . . . . . . . . . . . . 73

9. **Ecology and the Community**

James Sammons
Jamestown School . . . . . . . . . . . . . . . . . . . 87

10. **Biology and Health Science Class**

Perry Weston
High School for the Health Professions . . . . . . 94

11. **Human Ecology**

Frank Castelli and Jack Carney
Brandywine High School. . . . . . . . . . . . . . . 106

12. **Excellence in Teaching Biology: A Critique** . . 117

John E. Penick, Rodger W. Bybee and Ronald J. Bonnstetter

# PROLOGUE: SEEKING EXCELLENT BIOLOGY PROGRAMS

By

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Many descriptions of excellent ideas, activities, and complete science programs have been published, read, and reviewed; resulting in considerable improvement in science teaching and additional recognition of continuing problems. With this first volume of the **Focus on Excellence** monograph series, The National Science Teachers Association hopes to provide a source of inspiration, ideas, and resources as well as descriptions of innovative and successful practices. The ten biology programs described in this monograph are certainly innovative, successful, and inspirational.

For 1982, our search has been for outstanding programs in five focus areas; Biology, Elementary Science, Science as Inquiry, Physical Science, and Science/Technology/Society. For each area, we are devoting a monograph such as this describing innovative programs with a particular focus. This continuing monograph series from NSTA will highlight excellence in Middle School/Junior High Science, Physics, and Informal Science Education in Volume II. Future years will see a search for excellence in other school science areas, teacher education programs, and other aspects of science education. We feel strongly that this monograph series, **Focus on Excellence**, will play a needed and vital role in shaping science education practices and research of the future.

The 1982 Search For Excellence in Science Education began when Robert Yager, NSTA president for 1982-83, was invited to become a member of Project Synthesis. The perceived need for Project Synthesis came in 1976 when several National Science Foundation funded studies revealed the current state of science education in the United States. Then, in 1978, a synthesis of the more than 2,000 pages of information from those three NSF reports and from the National Assessment of Education Progress data was begun by twenty-three science educators throughout the U.S.

The Synthesis researchers worked independently in small teams, each focusing on one aspect of science education; Elementary Science, Biology, Physical Science, Science/Technology/ Society, or Inquiry. A critical part of the synthesis analysis was developing a description of an ideal or desired state for a focus area and then comparing the actual to the desired state. During the Search for Excellence, goals arising from the synthesis desired state for each of the five focus areas were used as criteria for defining excellence in a school science program.

Leading science educators (generally state science consultants) in each state were identified as chairs of committees to identify and nominate outstanding science programs in their respective states. Ultimately, 165 state nominations were submitted to the project director for consideration at the national level for 1982. Thus, the state exemplars were passed on to another set of review committees and yet another selection process.

To aid in the selection process, all nominees were asked to fill out forms detailing information on demographics, texts used, and the nature of the school. A questionnaire, developed from the desired state criteria, was completed by the nominee as an integral part of the nomination packet. In addition, the state nominees were given the major criteria for excellence and asked to provide narrative information about five aspects of their programs.

* Provide some information about the setting (community location, size, specific features, school science and organization);

* Describe the nature of the exemplary program (grade, level, class sizes, curriculum outline, learning activities, evaluation techniques);

* How does the program exemplify the 1982 criteria for SESE (Abbreviated criteria were made available and reference to Volume 3 of NSTA's What Research Says to the Science Teacher was given);

* How the exemplary program came into existence

* What factors contribute to the success of the program and what is needed to keep it going?

Nominations were divided into five groups; Biology, Physical Science, Science/Technology/Society, Inquiry, and Elementary Science. Each group was then reviewed by different teams with at least one of the original synthesis researchers on each team. Each program was compared to the desired state criteria and reviewed by at least four independent reviewers with reviewer discussion usually leading to a clear identification of the national exemplars in each focus area. These National Exemplars numbered twelve in Elementary Science, seven in Physical Science, and ten each in Biology, Science/ Technology/Society, and Inquiry. A separate monograph for each 1982 focus area is available from NSTA.

While Project Synthesis offered a desired state, these examples of excellence provide vivid views of what is already a reality. We hope you can profit through reading these descriptions by finding inspiration and a source of ideas. The programs described range in size from small schools to large, represent both urban and rural populations, and come from a broad geographical range. Schools with exemplary biology programs are found in communities of 1000 to those with more than 200,000. Size of school or community does not seem to be a limiting factor in achieving excellence. Some schools have large budgets while others have almost no money at all.

Grade level is not a factor either. Biology seems to work well regardless of the age of students. Not surprisingly, teachers are the most significant factor. Teachers in all of these programs are dynamic, thoughtful, young at heart, and eager to learn with their students. (If you are interested, see another monograph from NSTA, **Teachers in Exemplary Programs: How Do They Compare?**)

Chapter One describes **A New View for Biology Education.** Chapters two through eleven offer descriptions of the ten biology programs selected as exemplary during the 1982 Search For Excellence. Chapter twelve is a synthesis of the ideas found in these programs and a number of generalizations and recommendation relating to excellence in biology science programs.

These programs are all exemplary in various ways, but they by no means exhaust the supply of innovative and outstanding science education programs. We feel strongly that excellence exists and it exists in reasonable quantity. View these as **some** examples of excellence and be prepared to find more. At the same time, we encourage you to contact any of these exemplary programs which you feel have applicability to your own school situation.

# Chapter 1: A NEW VIEW FOR BIOLOGY EDUCATION

By

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It is safe to say that the message of crisis and change in biology education has been heard. Equally evident is the need to broaden our view of biology education to include social issues related to the life sciences. While the need to change biology education is clear and new directions have been suggested, a conceptual orientation is still needed. Without a new conceptual orientation we run the risk of either using old ideas that got us to our present situation or using such a variety of approaches that we lose a sense of unity and direction. We need not be caught on the horns of this dilemma.

This essay constructs a vision; one new way of viewing biology education. The essay, intended to provide a way through the dilemma, suggests human ecology as a new conceptual orientation for biology.

Some of the ideas expressed here have been described in earlier publications such as **What Research Says to the Science Teacher** Vol. 3, and the other articles listed at the end of this chapter. Review these publications if you wish an elaboration of new directions for biology education.

This introductory chapter describes a broad organizational scheme for a next phase in the evolution of biology education. More specifically, I wish to clarify human ecology as a conceptual orientation for biology teaching: to identify different issues within this conceptual orientation; to provide examples of biological problems, educational policies, curricular programs and instructional practices for biology education; and to review future prospects for biology education. Some of these goals are further clarified through the ten descriptions of exemplary biology programs in this monograph. While the tone of my essay is visionary and theoretical, many of the ideas are made concrete and practical in these exemplary programs. Before continuing, I would like to set the stage for later discussions by examining some crucial issues of biology and society.

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This article is based on work completed in the NSF program Project Synthesis. I wish to acknowledge Paul DeHart Hurd, Stanford University, Jane Butler Kahle, Purdue University, and Robert E. Yager, The University of Iowa, for their contributions to the formulation of ideas expressed in this paper.

## BIOLOGY, SOCIETY AND HUMAN ECOLOGY

In the last three decades advances in the biological sciences have been revolutionary. New theoretical insights such as sociobiology; new research technologies such as recombinant DNA; new perspectives such as biophysics, environmental psychology, and human ecology; and new approaches to understanding life and living have all emerged from biology. These new insights are influencing individuals as well as society.

Advances in the biological sciences have caused concern and debate because new knowledge and techniques can and are being applied to humans. Bioethical discussions of human engineering serve as an example of this point. The awareness that new biological discoveries apply to humans is a dimension not fully realized historically.

Embedded in these bioethical debates is an issue of tremendous concern to us all. Through most of time the immense journey of biological evolution has been directed by natural laws. With the discovery of DNA and development of biotechnology we are left with new abilities which may go beyond our visions. Evolution may now be directed by humans themselves. Here we see a clear and most profound connection between biology as a pure science and its influence on our society. All other insights pale in comparison. It should be noted that each report of new results and technologies leads us even closer to some drastic form of human intervention in natural processes. Examples are numerous; carbon dioxide in the atmosphere, acid rain, toxic waste, use of chemicals as fertilizers and food additives, and the creation of new life forms.

Other connections between biology and society exist as well. Most are now familiar sights in the catalogue of bio-social problems; population and pollution; environment, energy and resources. At some level the majority of bio-social problems affect the daily living of every person on this planet. It might be food shortages in third world countries or acid rain in developed countries, but they are there as a connection between biology and society. The increasing number and complexity of contemporary bio-social problems certainly cause us to question our wisdom in modifying or directing the evolutionary process.

The public has an increased awareness and concern relating to interactions among individuals, groups of individuals, and the environment. In the natural course of things public attention has been directed to primary units of ecological study. This attention and resulting perception has directly influenced the growing concern for ecology. But, there is the added dimension of public debate and social policies that extend the concern for ecology to the specific area of human ecology.

## HUMAN ECOLOGY

Human ecology considers the relations between the human community and the total environment. Human ecology is interdisciplinary. Strongly based in the biological discipline of ecology, human ecology integrates and unifies natural science disciplines with human science disciplines such as psychology, sociology, political science and economics. In addition, some humanistic disciplines, such as ethics, are also included in human ecology.

Why human ecology? First, the complexity of contemporary human problems related to biology requires that they be viewed in a context which includes their interrelatedness and holistic nature. Second, ecological scarcity (the ability of the environment to provide resources and receive and degrade wastes) is fundamental to many social issues, and we can no longer exclude the human influence in consideration of science related social problems. Third, we perceive best the ecosystem in which we live, and already this suggests a level of orientation for biology programs. We can best begin with the human scale and work toward an understanding of larger scales such as the biosphere, and smaller scales such as the microscopic realms of life. Fourth, students, as citizens now and in the future, must learn how to use the total environment responsibly and how to act responsibly toward each other as individuals and as communities and nations of individuals. This aim extends beyond presenting information about the environment. Something must be done with the knowledge--choices and decisions based on this knowledge must be made. At this level, instruction enters the realm of particularly human qualities such as values and ethics as these relate to personal decisions and social policies.

Human ecology is a new view, a conceptual orientation appropriate for contemporary biology education. Human ecology provides criteria for the selection and organization of biological knowledge, methods and values for textbooks, curriculum, and instruction. While other organizational schemes could be used, human ecology seems particularly suitable for this time in biology, society, and education.

## REFORMULATING THE GOALS OF BIOLOGY EDUCATION

Common sense would indicate that there is some biological knowledge, processes, skills and understandings that everyone should possess. Likewise, it seems equally clear that all biological knowledge, processes, skills and understandings cannot be taught in any specific course. Time versus the quantity of biological information are probably the primary constraints imposed on science teachers. Recognition of these assumptions mandates that we direct our attention to goals of biology teaching. Also, there must be periodic reformulation of goals to reflect changes occurring in biology, society and education.

We can begin constructing a new vision of biology education by identifying traditional goals, and then suggesting a reformulation of the goals in light of earlier discussions about biology and society. Through history, the actual goals of biology education have been few. These goals are briefly reviewed in the next paragraphs.

There is a body of knowledge concerning biological systems. For over two hundred years our educational programs have aimed toward informing students about biological systems. This goal has been and will continue to be one of great importance. Stated formally this goal is: **Biology education should lead to a fundamental understanding of biological systems.**

A second goal has been the use and understanding of the methods of scientific investigation. Sometimes called inquiry or discovery, descriptions of the goal have changed periodically, but fundamentally, the goal has remained the same. This goal reflects our concern that students understand, appreciate and, most importantly, use the processes biological scientists use in identifying and solving problems and gaining new knowledge. The goal is well stated as: **Biology education should develop a fundamental understanding of, and the ability to use, the methods of scientific investigation.**

Biological education exists in society and should contribute to the maintenance and development of the culture. This goal is especially important now when many social issues are directly related to biology. **Biology education should prepare citizens to make responsible decisions concerning science-related social issues.**

Within a culture, all individuals have needs that are related to their own biological/psychological systems. **Biological education should contribute to an understanding and fulfillment of personal needs, thus contributing to the development of the individuals.**

In addition, biological research, development and application continues through the work of individuals within the system and through the support of those not directly involved in biological work. So, one important goal has been: **Biological education should inform students about careers in biological and health sciences.**

The reformulation of these goals is based on a question: What is the purpose of biology education? An answer to this question is taken from Paul DeHart Hurd as he addressed the general topic of this essay. Dr. Hurd stated, "The overarching rationale of the desired biology program is the use of biological knowledge to enhance the understanding of oneself and to benefit the quality of life and living for human beings." (1, p.13).

Our task is primarily to prepare citizens capable of understanding and applying biology in their personal and social lives. There is a very important point implied by this aim. Biology education at the pre-college level, and aspects of college liberal arts courses, is **not** to train scientists, bio-technologists and doctors. The primary aim, the one directed to well over 90 percent of students taking biology courses, is related to biology in their personal and social lives. The contrast to this aim is found in discussions of the current crisis in science education. One aspect of the crisis is the need for scientists and engineers. While I am certainly not opposed to a preparation adequate to begin specific education for science and engineering, I do have serious reservations about restructuring the science curriculum specifically to ameliorate the need for biologists and bio-engineers. In my view, a desired biology education primarily provides for the needs of citizens. That is, we educate **all** students, including those going into science related careers. All must be scientifically literate if society is to achieve its highest aspirations.

The crucial issue, deciding what should be included in the biology program, begins by reformulating the future goals of biology in light of contemporary biological and social concerns. I say "future" goals to point out the theme of constructing a vision of a desired biology program. Also, I say future for the transformation of goals is a natural evolutionary process in biology education.

In the future, the goals of biological knowledge will include aspects of the basic conceptual principles in identifying living organisms; genetics, evolution, nutrition, behavior, continuity, structure-function, diversity-unity, life cycles, energetics, and integration. The future goal of biological knowledge will place these fundamental concepts in a context that is socially relevant and personally meaningful to students.

The limited application of science methods will necessarily be expanded in the future. To the extent inquiry is used by biology teachers, the focus is limited to specific skills such as observing, hypothesizing and experimenting. The goal of science methods will include information processing skills such as: holistic understanding of problems; multi-causal relationships; systemic thinking; qualitative methods of investigation; and methods of futures research. The accent on human ecology and social issues requires the inclusion of decision making as a critical component of information processing.

Few deny the importance of contemporary problems. However, many do not understand that even social, economic and political problems have consequences and are interrelated due to the more fundamental problem of ecological scarcity. Contemporary social problems are too important to ignore because they are "not clearly within the discipline of biology." Giving them marginal recognition through elective courses is no solution either. Biology education for citizens must center on societal issues which are and will continue to affect us and our environment.

Personal needs, along with societal issues, should be a primary orientation of the future biology program. "Pure" biology or the "structure of biology" are no longer sufficient organizational schemes for the broad and important goals of biology education. Human ecology with its attendant stress on the person as an individual in a complex society should become the organizational theme of biology education.

Increasing career awareness also will be a part of every topic in biology. In addition, the goal will be expanded from the traditional emphasis on great historical figures and research biologists to include the many and diverse careers within the biological, health, and environmental sciences.

## REDESIGNING THE BIOLOGY CURRICULUM

Among the major divisions of public education the biology curriculum will have a distinctly different orientation. At the elementary level the orientation will be toward children as "curious naturalists." Childhood is a time of interest, curiosity and wonder about the natural world. In the desired program teachers will use the common interests of children to develop their program. An added benefit of this approach is that elementary teachers need not have extensive science backgrounds. Many observations can be made in the immediate environment and be related to other parts of the curriculum such as language arts, reading, writing and arithmetic. This is an approach that could use naturalists such as John Muir as an example of a person who observed and wrote about the natural world.

The Middle School/Junior High School will focus on the "interested adolescent." Here the emphasis is on personal observations, biological and psychological development, and the role of the individual in human and physical environments. During the adolescent years, the biology program can again use the natural interest of students as a focus. Adolescents are keenly interested in themselves, peers, adults, and the human and physical environment.

The high school biology program, using "the informed citizen" as a theme, will emphasize the social context of biological concepts and processes. Biology as a discipline with a history and future will be studied. This is the level where human ecology will begin to have some meaning for students.

There are two considerations at the college level. The first is for students who do not intend to take any further science, while the second is for students who plan to continue their study in biology, bio-technology, environmental sciences, or health related careers. The first type of college course should be an elaboration in depth and breadth of "the informed citizen" theme. The second course of study needs little discussion since it is being done already. In general, the orientation is toward "the professional biologist."

Though brief, this discussion should introduce a new view for the biology curriculum. Each level of instruction has its own interests and emphasis. Study at the different levels is complimentary but not specifically designed to prepare for the next level in the traditional sense.

## RETHINKING INSTRUCTION IN BIOLOGY

As biology teachers construct new programs, I suggest they consider three questions:

* Is it teachable?

* Is it achievable?

* Is it learnable?

Teachable assumes a course of study appropriate to the teachers' background and interests. Answering this question may require some retraining or extra study, but professionals are expected to keep current with their fields.

Is it learnable relates to the students' ability to grasp the information, processes and skills presented. In short, this aim asks the teacher to consider the developmental and motivational needs of his or her students.

Is the program achievable also refers to the facilities, equipment, supplies and budgets. It does little good to design a program that requires elaborate facilities and equipment or is too expensive.

In a very broad way the curriculum described earlier is oriented toward the criteria of teachability, learnability and achievability. At all levels, there is recognition of teacher background, student development and facilities. As the program of biology education progresses, instruction requires higher levels of teacher competency in science, understanding higher levels of student development, and more sophisticated facilities and equipment.

There are other dimensions of the new view that are worth noting. While they are not necessarily new, they are not being used. Much greater stress will be placed on problem solving with problems ranging from simple ones in the early years to those more complex in later years of biology education. Likewise, greater atttention will be paid to individual and cooperative, as well as competitive, approaches to learning.

The role of the laboratory in the new biology program deserves special attention. To the degree laboratories were used in past biology programs, they were often thought to be "experimental" and usually done on a laboratory table. In the future, the approach will range from more **experiential** at the lower grade levels to the truly **experimental** at the graduate level. During the middle-junior high and high school years, the laboratory will be an equal combination of experiential and experimental. Laboratory activities will require students to locate sources of information in some cases and to discover new information in others. But, regardless of the source or means of information, the aim will be to identify and solve problems by using their knowledge of science. A part of the solution to many problems will involve making decisions. Ideally, a laboratory will be a confrontation between students and personal or social problems.

The best laboratories will direct students to information useful in making decisions and taking action. These laboratory activities should provide an interpretation and location of a real world problem to which students may apply their knowledge, skills or understanding. From this activity, forming concepts, developing process skills, and shaping of attitudes and values will come easily and naturally. Science will be viewed by students as a useful and essential part of their lives.

## SUMMARY AND DISCUSSION

A new view of biology education is reflected in goals, curriculum, instruction and evaluation that focus on helping students use biological knowledge, processes and skills to enhance their understanding of themselves and to benefit the quality of life and living for human beings. The study of humans and their environment is essential as it includes the individual's role in seeing, understanding and helping reduce contemporary problems. Biology taught with this orientation necessarily involves questions of ethics, values, morals and aesthetics. Human ecology is the conceptual organizer of the new biology program as it recognizes the centrality of humans in science, biology and science-related problems.

Goals of the new biology programs will be similar to those of the past; biological knowledge, science processes, social issues, personal needs and career awareness. However, the goals will be recast in terms of present and future changes in biology and society. The new biology program will focus on environmental or ecological studies including current issues requiring a biology knowledge base. Health--particulary those aspects dealing with topics such as alcohol, drugs, and tobacco--and disease are examples of topics that might be included. The quality of life in the future and how to enhance it will be stressed.

The new biology program requires no changes in time allotments in schools though it is a course which will be required of all students because the subject matter is primarily directed to improving human adaptation on both an individual and social basis. The program would have a different emphasis at different levels. Perhaps the "curious naturalist" at the elementary level, the "interested adolescent" at middle school and junior high levels, "the informed citizen" at high school and "the professional biologist" at college levels would be the appropriate program orientations.

In addition, the new biology program includes new foci for evaluation. Students will be evaluated on their ability to use knowledge of biology in interpreting personal problems and social issues, and a demonstrated ability to formulate rational decisions in the context of personal problems and social issues.

While text centered and traditional biology programs reflect biology as it was, human ecology as a proposed conceptual organizer for biology programs is more in harmony with the current state of the biological sciences and the contemporary social issues confronting citizens. Bringing this vision to reality will require the efforts of each biology teacher for programs must be tailored to the unique human ecology that exists with each teacher, group of students and school facility.

A broad new view has been presented in this essay. There is proof that the vision of this essay can become reality. The proof is in the exemplary programs that follow. I hope this package of the ideal and real provides confidence that the reader can begin developing a new view of biology education.

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# Chapter 2: LINDLEARN BIOLOGY

By

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Lindenhurst, a community of 38,000, would best be described as low middle income and very heterogeneous ethnically. Our community, through Superintendents, Boards of Education and building principals, has always supported education. They have nurtured innovative chairpersons at the secondary level by allowing these individuals to be educational leaders. The ability of the chairpersons from all disciplines is limited only by their vision, drive, knowledge, and by their ability to motivate staff, stay current, and communicate with all decision-making administrators, including the Board of Education.

Our 22 year old high school has 2,614 students and 166 teachers in grades 9 through 12. Originally, it was a junior high school, now converted to a high school. If we had a new high school, the science rooms would have been larger. As a result, we have a problem with storage space for science supplies, equipment, and Lindlearn Biology material.

The science department's 21 teachers use multipurpose laboratory-lecture science rooms containing laboratory stations for 30 students. Our 15m x 4m Solarium, built by our science students in 1982, is our 17th science room. This facility not only serves as a greenhouse for hydroponics and plants, but is a source of heat for part of the high school in the winter. The district's planetarium and two meter earth-in-space globe located at the Junior High School are used in the high school science program as well.

## OUR BEGINNINGS

Our old biology program was a traditional textbook approach with labs and evaluative measures the choice of each biology teacher in the district. The quality and quantity of biology varied greatly and personal and social issues of biology were not part of any teacher's resource or classroom materials. Whether social problems were discussed in lecture or discussions with large groups was left up to each teacher. Career information was non-existent.

Each teacher in the old biology program followed the New York State Biology Regents syllabus, insuring all students were exposed to the same materials. While each teacher had core material with which all students had to be familiar, teachers could select existing materials as enrichment for their students. A majority of the staff completed all designated enrichment areas with students. In using any New York State syllabus, the teacher has unlimited opportunity to expand any area dependent upon the ability and interests of the class. But, we were not content with what we were doing or how we were going about it. We faced two problems which, while not unique, are rarely addressed:

* How can we effectively provide for students with widely varying skills, interests, and degrees of motivation?

* How can our biology classes better reflect the nature of science?

Science is a way of thinking and knowing; the progress of science is dependent upon the ability to think logically. High school students demonstrate varying degrees of success in applying logical thinking to problem identification, problem solving, planning, evaluation, and analysis of data. Lindlearn Biology is designed to develop and refine these skills. The target population for Lindlearn Science is students who meet any two of three criteria:

* An I.Q. score of 100 or better on the California Test of Mental Maturity (given in 8th grade);

* Reading ability not more than one year below grade level as determined by the Stanford Achievement Test (given in 8th grade);

* Successful completion of the last science course.

Students may elect to take Lindlearn Biology either in a more structured or an individualized setting. Since the great range of difference among pupils is probably the most pervasive characteristic of our student population, and since we knew they learn better by different modalities, it was necessary to obtain media materials in advance of any curriculum development. Without any additional funds for buying equipment, supplies, or media materials, the Science Department from 1968 on began reallocating its priorities to develop a multimode approach. This gave us a three year lead time before developing and pilot testing the program.

Rhona Margolis, William Nast, Robert D'Esposito, Dr. James Brucia, and I then developed and pilot-tested Lindlearn Biology over a three year period. The New York State Biology Regents Syllabus has served as the basis for developing the core objectives for Lindlearn Biology. The district has a curriculum committee made up of central administration, principals, teachers and one member from the Board of Education. This committee serves to monitor curriculum development. They play a major role in seeing that programs develop students properly at a quality level. As programs are developed and pilot tested in the classroom, they are finally recommended to the Board of Education for adoption and can become part of the regular curriculum.

Programs of this magnitude cannot arise without teachers being given time to develop them, either by being compensated during the summer or year or given a curriculum period in place of a duty period within the school day. The Lindlearn program has used all three of these ways to evolve and undergo change.

As we developed our personalized program, we realized the need for two important kinds of assistance. First, we needed a secretary who could type new or revised materials. Second, we needed helpers who could duplicate and collate materials. We did not hire new people. Instead, the district reassigned employees within the district. Since our personalized program used more paper than a traditional program, the district also had to reallocate funds from another area to buy paper. We have had the full cooperation of all our Superintendents and Boards of Education through the years. They have supported not only the personalized programs in the sciences, but also those in art, social studies, English, mathematics, French and Spanish.

As Chairperson of the Science Department, I have been involved in planning, program development, staff development, program revisions, and evaluation. My active participation in professional oranizations such as the **American Chemical Society** and **The National Science Teachers Association,** and my term as President of the New York State Science Supervisor's Association gave me contacts and experience which were valuable in organizing our program.

Our notions of curriculum and instruction were influenced by those contacts, our own ERIC searches and the **NSTA** publications **What Research Says to the Science Teacher** - Volumes 1, 2, 3 and 4. Also, I was in daily communication with the test teacher during the pilot stages of the program, both outside and inside the classroom. Then, the communication among the initial four teachers in the program kept ideas alive until each person had faith and experience in the program. All staff members, with the exception of myself, had only experienced traditional classrooms in their own educational backgrounds.

## OUR PROGRAM

At the beginning of the pilot program teachers would not believe students could learn without lecture. Teachers knew they should not lecture; still, when students asked questions, extensive lectures usually followed. When this occurred, sometimes the biology teacher in the next room would hear it and would start tapping on the wall with a meter stick, serving as a reminder to the teacher who was lecturing to stop. It was difficult at first to break the "leture method." It took teachers helping each other to break the habit. Soon, I began to hear new comments such as "I can't believe it. They learned that objective without me."

At the end of the second year of pilot testing, some of the biology teachers were still "doubting Thomases." Finally, after three years, all of the biology teachers indicated they never wanted to go back to the old biology program.

Our desired outcomes parallel those stated by our State Education Department:

- Mastery of the basic skills of communication and reasoning;
- Ability to sustain lifetime learning
- Ability to maintain one's mental, physical and emotional health;
- Understanding of human relations
- Competence in the processes of developing values;

- Knowledge of the Humanities, Social Sciences, and Natural Sciences;
- Occupational competence
- Knowledge and appreciation of our culture
- Understanding of the processes of effective citizenship;
- Knowledge of the environment.

Regardless of whether this is in a traditional or individualized setting, students take considerable responsibility for learning. Each successive science course these students take, all structured like Lindlearn Biology, forces them to be more independent and to utilize their ability to teach themselves.

Values as they relate to life and the environment flow from the students and teachers having the opportunity to interrelate in small groups. When it is desired, this activity can culminate with an entire class discussion. And, the Lindlearn Biology contributes significantly to basic skills and value goals rather than narrowly stressing knowledge goals. The required writing, as a culmination of all multimode activities, involves interpretation, data collection, and writing skills. The writing experience helps students develop insight as well as reinforces the understanding and retention of scientific concepts.

The Lindlearn Biology environment is holistic and interdisciplinary, giving students opportunities to internalize and discuss current and future social-cultural-biological problems. These problems help students discover what alternatives will improve the quality of human existence in the future.

About one-fifth of the laboratory activities, filmloops and social problem/social action activities use the processes of inquiry. Any increase in the inquiry process in future development of Lindlearn Biology will be in personal/social biology. In Unit One, "Unity and Diversity Among Living Things," there are fifty different careers noted with the required number of years of education after high school and a brief description of the subject area and science application of the concept to be observed in the real world. Presently, our basic seven units have over three hundred suggested student career opportunities. Career information flows in a unified way as part of the total learning process.

Students enter our science program with cultural values and belief systems which influence strongly what and how they learn. In Lindlearn Biology, they clarify their own values and ethics when discussing such questions as "When does life begin?", "When does one cut off the life support system?", "Euthanasia?", "What social implications would occur if you were cloned?", "What would be the social implications if you never grew old?", or "What would be the social implications if you lived to be 150 years old?" Students discuss such questions when they are relevant to cognitive information being studied.

With the 1979 revision of Lindlearn Biology, humankind as a central focus was initiated. The concept permeates Unit 3: Human Physiology, Unit 4: Reproduction and Development, Unit 5: Transmission of Traits, and Unit 7: Plants and Animals in Their Environment. Also, the other three units focus on humanistic issues occassionally. All units have some point where the student is the center of attention. For example, there are small group discussions comparing an individual student's genetic characteristics to his parent's characteristics and to those members within the group. Since high school biology books have little or no personal and social concepts in a human context in the subject matter, locally developed activities relate biological information to personal and social problems or personal and social actions. However, we have a considerable amount of development to do before we reach the point where students recognize the interdisciplinary approach of personal/social biology as a means to better human progress and better life.

Whether the materials are used in a traditional or individualized classroom, the students are active participants in the learning process and not passive learners as in the traditional lecturing model. Students usually work in groups of two to four where they, as well as the teacher, can discuss ideas and materials. Students are not only reacting to some mode of instruction but they have to write as well.

Since students learn in different ways, almost all behavioral objectives have more than one activity, each using different modes of instruction for students to learn the objective. Since the materials and the student monitoring system are so well organized, students who are absent can easily make up work. A matrix makes it easy for the teacher and student to select what activities or mode of instruction will achieve an objective. This same matrix permits students to recycle themselves after ACE tests, pre-post tests or post-tests. The self motivation and direction provided by the materials is a highly effective, already-devised lesson plan for a substitute in the absence of the regular teacher. There is no interruption in the learning process.

Teachers help students discover and clarify their own personal values instead of trying to force others values on them. In 1982, a nucleus of students from the Lindlearn Biology classes embarked on a feasibility study to use passive energy for the high school. Three students had their project selected as one of the 85 named as winners in October 1981, chosen from 170 New York State contestants. Their project was funded with $500 to compete in the State Energy and Research Development Authority competition at the end of April 1982. In the meantime, the School Board members were so impressed with the student's model that they authorized $9,000 for materials to build a 45 by 12 foot solar classroom for the high school. It is the first student-designed solar project to achieve this distinction.

The solar classroom saves up to $3,000 a year in oil costs, and serves as an experimental greenhouse for all 560 biology students. It is noteworthy that students from the Science Department put up this structure. For any Board of Education to expend funds which were not budgeted is rare. These same classes of Lindlearn Biology students met with Grumman Energy Systems who donated complete working solar panel systems of different designs. Without the work of the students from the Lindlearn Biology classes, this would never have occurred. The students' concern over environmental problems was felt with such intensity they were able to move and affect the environmental values of the Superintendent of Schools and the Board of Education.

All our biology classrooms are multi-purpose rooms with moveable tables giving teachers and students maximum flexibility each day. Each room has gas, water, compressed air and thirty laboratory stations. Displays and pictures around the room give them an inviting and warm atmosphere. Each Lindlearn Biology room is equipped with four filmstrip previewers, a slide projector, and an 8mm movie projector. Each room has six tape players, four filmstrip previewers and four listening stations for 24 to 32 students. Having rooms like these makes it possible for all types of activities to take place at once in the same room. Special equipment, such as carousel projectors and 8mm Kodak projectors are stored in cabinets which have special locks and keys for teachers in the Lindlearn program. Headsets, filmstrip previewers, and listening centers are stored in separate boxes in the prep room where students have easy access to them.

Lindlearn Biology booklets, program materials, media and three different class sets of biology reference books are accessible from the prep room and classroom. Response sheets, activity centered exercises (ACE) and tests are stored in nearly 800 coded file folders. As materials are needed, the coded folders are placed in boxes. Most of the labs are in covered trays in cabinets and are coded into the program. Depending on the activity, there are readily available at least three to fifteen sets of all activities which may be used by students at any time during the course. If a kit is low or out of materials, the kit is put aside for the teacher. Students pick up and return in a neat and orderly fashion all materials used during the period.

For teachers to help students discover and clarify their personal values and discuss ethical science-related problems in the classroom, without forcing their own value system on students, requires special skills. Fortunately, when we developed our program in 1968, this was the beginning of their developing the mode of teaching and change in philosophy necessary for examining science social problems and actions for improving human welfare and progress. We have had much time to change ourselves so we can educate students. If a new teacher joined our Science Program, we would initiate on the job inservice experiences.

The New York State Biology Syllabus has seven units providing the cognitive base for students to develop values. Threads of ecological and environmental concerns are integrated in Unit 2 "Maintenance in Living Things," Unit 4 "Reproduction and Development," Unit 5 "The Transmission of Traits from Generation to Generation," and Unit 6 "Evolution and Diversity." Unit 7, the Ecology Unit, is "Plants and Animals in Their Environment," Unit 3 "Human Physiology" includes how common malfunctions of health may occur with the various human systems and how one's mental and physical health problems throughout life are influenced by controlling environmental conditions and health habits.

At first, students complained that they would rather be in a traditional biology classroom where they could be passive learners with less work, less writing, and responsibility for fewer activities. Through the years, teacher and student attitudes have changed. You hear comments in the classroom, "You mean all high schools don't have this program?. I thought everyone had Lindlearn."

Although lessons are preplanned, students determine pace, emphases, and timing of evaluation. As students come into the room, they put their books down and pick up any activities handed in the previous day. They also pick up the material they need for the steps they plan to do that day and begin working, usually in groups of two, three or four. During the period, students check the student monitoring sheets to see what activities they have completed and what activities are awaiting completion. In a class of twenty-eight students you can see seven to twelve groups working on different activities. As students finish one step, they hand it in and start the next step. If there is an ACE test after a particular step they go to the teacher's desk and pick up the quiz. After finishing the ACE test, their answers are checked using the key on the teachers' desk and then handed in. As students have questions, problems, or want to discuss an environmental or social problem, the teacher serves as facilitator, clarifier or resource person. If a group is having difficulty, the student asking for assistance may hear a brief lecture or they may experience a combination of stimulating questions which help the students understand the problem.

Since most Read and Write exercises are done as homework, as students enter the room they may express their difficulties to the teacher and as a class request a lecture. The lecture or discussion might be fifteen minutes or the whole period. This may occur three or four times a month. Though students are permitted the freedom of rate, they know they must finish the core activities, ACE tests, and pre- post test by a target date when the post-test must be taken. Students who are going faster may take the post-test when they finish a unipart and continue on to the next unipart.

Regardless of whether the program is traditional or individualized, the teacher is on-stage less. This does not mean the class never has discussion, mini-lecture, or full-period lecture. What is necessary or required is determined by the teacher and the students. No two teachers or two classes are exactly the same. One of the outcomes of the program is that discipline problems have become nonexistent. Other high schools adopting our program report a similar lack of problems. Students work at their activities in a self-directed and purposeful way as the teacher's role gradually becomes one of facilitator, resource person, and, on occasion, guide.

Before the students come into the classroom, the teacher must have booklets, response sheets, ACE tests, pre-post tests, post-tests, media materials, lab materials, timeline, and prior day student materials organized. As students begin working in groups, the teacher observes how each group is functioning. Depending on the activity, students often ask questions or initiate discussion. Teacher interaction with students informs the teacher how students are achieving the objectives and how effective the materials are for a particular objective. If the students request a lecture, the teacher usually obliges. The teacher also may have three to four planned lectures or discussion/lectures a month. What discussion evolves may be focused or may be holistic and interdisciplinary in context as the cognitive intellectual achievement relates to such areas as human ecology, human genetics, or environmental psychology. Some days the teacher may be involved very little with the students.

When the students leave, they have handed in seven to nine different ACE response sheets, three to four different ACE tests, and perhaps a pre-post test or post-test. To keep track of where students are at all times the teacher has a student monitoring grid sheet which horizontally, across the top, lists the activities, ACE test, pre-post test and post-test. As teachers correct what has been handed in, they record it on the student monitoring sheet. The student monitoring sheet must be kept current so the teacher and the students know where they are each day. If an activity is not satisfactory, the student must do it over. Since students are doing many different activities, the student monitoring sheet will look like a scattergram.

Program materials consist of learning activity booklets (called uniparts), response sheets, pre-tests, mini-quizzes, pre-post tests, post-tests. Each unipart contains coded behavioral objectives, a flow sheet of activities, a matrix, and details for each activity. Students have short range goals and they know exactly what they are expected to learn. Each behavioral objective has a minimum of three criterion referenced questions. The same objective is approached in a variety of ways. The student learns an objective, usually using at least three modes: filmstrip, filmstrip/tape, audiotape, slide, slide/tape, single concept 8mm film/tape, microslide, program material, laboratory activity, reading, mini lecture, small group discussion or selected lecture topics. This variety makes it possible for students of varying reading ability and different learning styles to be successful. This is one of the strongest aspects of the program. The testing program lets the students know exactly what objective they have learned or missed. The model is constructed so the student can easily be recycled by doing an activity for a specific objective and then be retested for the same objective. Students have specific timelines which they must meet for finishing activities whether they are in the individualized or traditional Lindlearn Biology model. The teacher develops timelines for each unipart so students know when they must finish each one.

## LINDLEARN TIMELINE

We follow suggested Lindlearn Biology Timelines. Times vary depending on the teachers management system and student ability level; some gifted students have finished the entire program in one semester.

| | | | |
|---|---|---|---|
| 1.1 | The Cell - Basic Unit of Life - Cell Organelles and Their Functions | 17 days | 25 periods |
| 1.2 | The Chemistry of Living Things | 14 days | 21 periods |
| 1.3 | The Roll Call of Living Things | 3 days | 4 periods |
| 2.1 | Nutrition in Lower Animals | 5 days | 8 periods |
| 2.2 | Digestion in Plants | 3 days | 5 periods |
| 2.3 | Animal Transport | 6 days | 9 periods |
| 2.4 | Plant Transport | 3 days | 5 periods |
| 2.5 | Animal Excretion | 8 days | 12 periods |
| 2.6 | Plant Respiration Excretion | 3 days | 5 periods |
| 2.7 | Animal Regulation-The Endocrine Syst. | 5 days | 7 periods |
| 2.8 | Plant Regulation Growth | 3 days | 5 periods |
| 2.9 | Dissection and Comparison of Representative Animal and Animal-like Protists | | |
| 3.1 | Digestion in Man | 6 days | 9 periods |
| 3.2 | Circulation in Man | 7 days | 11 periods |
| 3.3 | Respiration in Man | 8 days | 12 periods |
| 3.4 | Nervous System of Man | 7 days | 10 periods |
| 4.1 | Reproduction and Development | 10 days | 14 periods |
| 4.2 | Asexual Reproduction | 4 days | 6 periods |
| 4.3 | Sexual Reproduction in Animals | 5 days | 8 periods |
| 4.4 | Sexual Reproduction in Plants | 3 days | 4 periods |
| 4.5 | Human Reproduction | 4 days | 6 periods |
| 5.1 | Patterns of Heredity - Mendelian Genetics | 8 days | 12 periods |

| | | | |
|---|---|---|---|
| 5.2 | General Patterns of Heredity | 5 days | 8 periods |
| 5.3 | Changes in Heredity: Mutations, Cross-Over and Non-Disjunction | 5 days | 7 periods |
| 5.4 | Environment and Heredity, Human Genetics, Plant and Animal Budding | 2 days | 3 periods |
| 5.5 | Modern Genetics | 6 days | 9 periods |
| 5.6 | Population Genetics | 3 days | 4 periods |
| 5.7 | Genetic Research - Cloning | 3 days | 4 periods |
| 6.1 | Evidence for Evolution and Transmission of Variations | 3 days | 5 periods |
| 6.2 | Theories of Evolution | 4 days | 6 periods |
| 6.3 | Origin and Early Evolution of Life | 2 days | 3 periods |
| 6.4 | Transmission of Variations | 2 days | 3 periods |
| 7.1 | Plants and Animals in Their Environment | 5 days | 7 periods |
| 7.2 | The Biosphere and Man | 4 days | 6 periods |

Since the program requires no special setting and is individualized in approach, administrative problems of schedule, transfer, grouping and budget are minimized. In May 1980, the Lindlearn Biology method was recognized by the New York State Education Department as an appropriate method of providing for the gifted and talented in the regular classroom--a boon to administrator and Board member alike. Since we offer biology, chemistry and physics all in the Lindlearn format, students can take all these sciences at their own rate.

## EVALUATION

Testing and evaluation using scientific knowledge to interpret personal and social issues is of intrinsic value for students currently in the Lindlearn program. It is the student-student and teacher-student interrelationships which form the personal/social aspect of our current biology program. We are changing the Lindlearn Biology program so the materials, instead of the teacher, become the source which primarily motivates students to discover the interconnectedness of events, both people and biological.

All activities, except Read and Write activities, have Activity Centered Exercise quizzes (ACE tests). The pre-post tests, which orginally were pre-tests in the program, came about from student input. Students convinced the staff that this instrument had much more value after a student had completed all the activities in a unipart. All students take the post-test after they have successfully completed the pre-post test.

We have developed a computer bank of criterion referenced questions, coded to the behavioral objectives and the matrix in Lindlearn Biology, Lindlearn Chemistry and Lindlearn Physics. Each objective has a minimum of four questions. From the thousands of questions in biology we currently have, teachers can make up as many versions of quizzes, pre-post tests and post-tests as they wish. Using mastery learning techniques a teacher can retest students just on the objectives they have missed.

In comparing the achievement of the Lindlearn Biology students to overall New York State (NYS) student achievement on the NYS Biology Regents examination, Lindlearn Biology students do significantly better. The NYS (1981) mean was 78.3, percent passing was 82.2 while the Lindlearn Biology student mean was 83 and the percent passing was 96 percent.

In 1979-80 one of the Lindlearn Biology students won fist prize in the area of Physical Science and Technology from the New York Institutes Einstein Centennial Science Fair. The panel of judges selected this student's project as being the most original at the Fair. In 1980-81, two students not only won the local New York State Energy Research and Development Authority's award, but they came in sixth at the NYS Science Energy Fair.

Evaluation of personal needs and social issues is currently integrated into small and large group discussions. In all units no formal evaluation as to a student's growth is conducted in these areas. An evaluation device needs to be developed which is directly correlated with objectives and activities.

Every ten years (1970, 1980), we do an extensive survey of students in sciences from grades 7-12. From these surveys, we see how student interest and needs are changing for all age levels and we respond to most needs expressed by our students.

Fortunately, we have numerous gifted computer programmers who can write programs and science teachers who write commercial science software. By using these special talents, social and personal problem issue situations can be created. Through student interaction with computer programs, they learn the possible consequences of their decisions. We have the computer programs that not only permit the creation of these but monitor each student's progress as well.

Even though we do not have microcomputer equipment available outside of our computer science class, our district has already committed part of the block grant money we receive from the state for the next three years for science teachers to develop this type of computer program. This program will not only add to our evaluation system, but the small and large group discussion will be able to flow from some of the computer program activities.

We could better evaluate the outcomes of our program if we could follow students in studies every two or four years after graduation from high school. The staff and the chairperson have developed and used a number of Likert type evaluations in the affective domain with our science programs. As soon as the 12 microcomputers, disc drives and printers arrive for our third computer science room, this will free up at least three microcomputers for staff to develop new Lindlearn Biology software. We already have the necessary equipment to begin piloting the new activities and evaluative measures in the spring of next year. I expect this phase of development to be intensive for at least five years. The development rate will depend on money availability for computer hardware.

In the Science Department, we have done three cognitive domain studies (1973, 1976, 1980) and two affective domain studies (1976, 1980). In the first study, two classes, a control group of Lindlearn Biology students and a group of students with similar reading ability and I.Q., taught by the same teacher, took a fifty item test made up of regents questions. The Lindlearn group did significantly better than the control group. In the 1975-76 and 79-80 studies, one-hundred students were randomly selected from the Lindlearn Biology and one-hundred from the traditional biology classes who took the 1976 and 1980 Biology Regents exams. Under these conditions, we can say ninety-five percent of the students will do better in a Lindlearn Biology program than in a traditional biology program. We have also found that Lindlearn Biology has more of an impact on improving the achievement of average and below average students than above average students.

In the 1975-76 affective domain study, ninety-six percent of the Lindlearn Biology students indicated they preferred Lindlearn Biology to the traditional biology program. A comment by one of the students which best describes an outcome of Lindlearn Biology was "It gives the student responsibility, which is the way life is."

The 1980 affective domain survey was an interest survey. Of the 300 students taking Lindlearn Biology, seventy percent indicated a desire to take future half-year or year biology courses in twenty-two different areas. It is unfortunate that we cannot offer all of the areas in which students have an interest. This type of survey we do every ten years. We have found students' areas of interest do change and our diversified Science curriculum reflects these changes as much as time and money will permit.

Since all of the teachers have between twelve and twenty years experience, the challenge is to keep them viable and alive for students. This can only occur if they are given the freedom to be at the cutting edge of progress and be allowed to create. As one of the program originators said, "Lindlearn keeps me vital in teaching rather than stagnant, teaching the same thing day after day. It helps me get closer to my students; they are not just faces, they are individuals." As chairperson, I must see that teachers have the necessary materials to create an atmosphere which nutures each person's strengths.

The atmosphere in a building is set by the principal's style. We have had four different principals in the high school since the inception of Lindlearn in 1968, but each has permitted the chairperson to create programs with their staff. It was the principal who kept central administration informed of the changes taking place and who created time for all departments developing curriculum. By freeing teachers to work on curriculum, the duty periods for building management were decreased. We have been fortunate and it will allow us to continue growing.

## SOME NEEDS

We have a sizeable investment in media and equipment. Lindlearn Biology booklets and materials cost $4.75 per student. A classroom set includes ACE tests pre-post tests, post-tests and a teacher's edition. If a district has its own duplicating system, it can produce classroom sets for the program. Final cost depends upon what a district has in its current inventory of media materials, media equipment and textbooks. A district can probably phase in the program over a period of three to five years as a part of its normal budget.

Periodicals such as **Conservationist, Science Times** (New York Times), **Scientific American, The Science Teacher, Science News, The American Biology Teacher, Coastal Reporter** (American Letteral Society) all serve as resources for teachers in the classroom.

We have found a secretary must be available for typing the curriculum and curriculum changes. It would be difficult in a school our size to operate without a secretary. A copy machine which can easily duplicate and collate materials is a necessity.

The following are some of the changes we are planning to make in the Lindlearn Biology:

* Write microcomputer software which will replace or be additions to present cognitive activities;
* Write microcomputer software which creates personal and social situations which indiviudal and/or small groups may interact with as activities and student evaluation;
* Write and code affective objectives into the cognitive objectives, activities and evaluative measures;
* Write microcomputer software which will monitor student progress as they do cognitive and affective activities; We already have a main frame computer (Digital PDP10) which can monitor students' cognitive progress and prescribe activities for students;
* As new commercial media comes out it needs to be evaluated. Staff modify the written material so the new media replace the old or introduce new areas into the program. With all new additions, coded behavioral objectives would be written and coded to activities, ACE tests, Pre-post test and Post-test.

Of the twenty teachers on my staff, all but two are now using some form of Lindlearn Science. However, it took some staff members ten years before they were psychologically ready to use Lindlearn Science in the classroom. All biology teachers now use the Lindlearn Biology materials. To prepare teachers we developed individualized inservice teacher training materials which we use with all new teachers. During the past five years of training teachers in using Lindlearn Biology, we have found certain key activities which must occur during the training workshop. Teachers must understand:

* How to organize material - all pre-tests, response sheets, quizzes, pre-post tests and post-tests placed in file folders (coded) and all media materials coded into the program by the teacher trainee.
  These two activities help the teacher become familiar with the various parts of the program quickly.
* Room organization - security, equipment and room management.
* Planning for the first day, week, and month.
  Teachers are most anxious about this.
* How to use the teacher's guide, which includes for each unipart, timelines for each activity, core activities, optional and extended activities, class activities vs. activities which can be done outside the classroom.
* Student management systems and how to monitor student progress.
* Duplicating system.
* Anticipated problems and educational change.

Teacher education should include both traditional and individualized experiences during student teaching. To have only one or the other is not what the teacher is apt to experience in the real world. If teachers are expected to function in classrooms where students are an active part of the learning environment, they need to experience learning by being active learners themselves.

Skills, attitudes and knowledge a new teacher needs to have in order to begin this program are:

* An intense desire to want to do the Lindlearn program
* The ability to interrelate, communicate easily and accept all types of students;
* A good self-image
* The willingness to listen to and communicate freely and openly any theory or problems he or she may have;
* The desire to keep current with science literature, not only for changes occurring in the cognitive areas, but in affective and social areas of biology as well;
* Have computer literacy
* The desire to be a contributor in improving the program.

But, no teacher should attempt this program unless they are really enthusiastic about its possibilities and challenges. They must be super organized individuals who can interrelate with students of all types with empathy, respect, warmth, genuineness, concreteness and constructive confrontation. If I wanted to cause failure of the program, I would have teachers:

* Use the program who really did not want to
* Who couldn't interrelate with all types of students with an accepting attitude;
* Who had to run off and collate all the Lindlearn Biology materials and/or
* Who are not organized.

The target population in replicating schools varies from Rhinecliff Union Free School District, Holy Cross Campus, Rhinecliff, New York, where 100% of the students have learning disabilities and/or educational weaknesses as a result of failure within the traditional education environment to the accelerated honors students of Tottenville High School, New York, New York.

Since the program is dynamic and not static, it is constantly undergoing change. Teachers, who do the revisions, are given a free period to do curriculum work in place of having a building duty assignment. Also, every teacher in the Lindlearn program during the past five years has had the opportunity to train teachers of replicating schools who are introducing Lindlearn Biology into their classrooms.

Each year the administration gives recognition letters to staff members who have contributed to the district, trained teachers in replicating schools, or worked with the many visitors we have every year. These letters of recognition are very important for staff members to receive and a copy is always placed in the teacher's district file.

We encourage and expect good teaching. Like any educational program, the teacher is the key to the success or failure of the program: **Good Teachers Do Make a Difference.**

# Chapter 3: MODIFIED TEAM APPROACH TO TEACHING BIOLOGY

By

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Cherry Creek High School draws from a suburban, middle class area of 100,000 people. Overall, the community is very supportive of education with most of our tax base coming from two large office complexes. Home and real estate values appreciate, in part, because of the desire of many people to have their children in the Cherry Creek Schools. Our school population is growing by four to ten percent per year.

Cherry Creek High School is one of three high schools in Cherry Creek School District 5 in Arapahoe County. There are 190 teachers at CCHS with 3,400 students in grades 9 through 12. Built in 1954, CCHS is strong in academics with eighty percent of our students going on to college. Also included in the curriculum are vocational and off-campus classes to meet the needs of non-college bound students. Our school includes an animal room, a greenhouse, and a large courtyard for a future environmental study area. We are located within walking distance of a state recreational area which can be used for environmental studies.

## OUR GOALS

We are striving to meet the needs of a broad range of students. Our goal is to offer students insights on life from molecules to the biosphere so that they might use them in interpretation and understanding of self and total environment. Assignments cover a broad range with many alternative paths for students to choose in accordance with their own particular interests and needs, couched within a framework of essential understandings and skills. Our desire is to encourage students to use biology in their everyday lives. Also, we want to help them:

* Understand the nature of scientific inquiry
Science is an
open-ended intellectual activity and what is presently "known" is subject to change at any time.
* Understand the limitations of science and of the scientific method;
* Understand the diversity of life and the interrelationship of all organisms;
* Understand the biological basis of problems in other fields
* Understand the historical development of biological concepts and their dependence upon the nature of the society and technology of each age;

- Understand man's own place in nature, namely, that he is a living organism that interacts with all organisms, including fellow man, in the biosphere and that he must live in balance with nature;
- Understand how to locate science information in the Science Resource Center and libraries;
- Develop the ability to observe, classify, define problems, hypothesize, record and interpret data, and draw conclusions in biological experimentation;
- Appreciate social aspects of topics such as overpopulation, birth control, abortion, and energy use;
- Enjoy a quality life unpolluted by overpopulation.

We emphasize human adaptation and alternative futures by discussing the consequences of overpopulation, values clarification, quality of life, heredity, and genetic engineering. Other social problems and issues addressed through the program include drug awareness, sexually transmitted diseases, birth control, abortion, anti-smoking and chewing, ecology, birth defects, and genetic counseling. In all of these discussions we consider value, ethical and moral considerations of science-related problems as an integral part of the decision-making process. We attempt also to integrate career awareness as part of each unit. Our school provides a health fair and Medical Careers is a course offered as a credit option.

In analyzing our goals for students and our vision of a good biology program, we feel strongly that working as a team rather than as isolated teachers better reflects these goals while making our teaching more effective. We have found ourselves learning while enjoying our teaching more.

## OUR PROGRAM

The forerunner to our team approach was a program at Alameda High School in Lakewood, Colorado, where Raylene Owen taught. When she came to the Cherry Creek District, she brought five years of teaming experience that she and Russ Doren used to create the first team at Cherry Creek High School. They were later joined by Pat Huwa and Sally Swartz. The team also borrowed from a similar course taught by William Owen at a small rural high school. The team, in its present form, has existed since 1977. These four teachers represent 53 years of teaching experience, three of the four have Masters Degrees, and the fourth has the equivalent of a Masters in course work. All team members are continually involved in taking classes, giving seminars to fellow teachers, and are active in NABT, CBTA, NSTA, and CAST.

This program did not develop overnight. It is the culmination and refinement of many years of work in our attempt to teach the best and most relevant biology course possible, as well as to meet the current needs of the students and the community. Our sources of inspiration include workshops, conferences, professional growth, other teachers, students, teaching experience, and the **BSCS Green Version**. These sources led to inquiry teaching strategies and an emphasis on many societal issues as well as more traditional biology topics.

The team emphasizes an overview or survey course in biology. All areas are presented, and no teacher is allowed to "get stuck" in his pet area. General topics we consider essential are:

- Ecology
- Plant and Animal Taxonomy
- Anatomy and Physiology
- Reproduction
- Protists: Taxonomy and Disease
- World Biomes
- Cells
- Heredity
- Man and His Place in the Biosphere.

In all areas of this survey course of traditional biology topics, we make a concentrated effort to relate current social concerns to scientifically supported alternative solutions.

While we are studying biology in general, humankind is a central focus. Emphasis is placed on the human quality of life in biology, not only in the subject matter but also in the laboratory interactions between teachers and students as well as among the students themselves. We are constantly relating man to his place in the scheme of things. The student is taught that if technology is removed, man is not more important than any other animal in the food chain. Emphasis is on learning about other organisms and living within the natural structures while causing as little disturbance as possible.

When discussing the local and community relevance, we emphasize that the whole world does not live as we do. The team incorporates the local March of Dimes, Action on Smoking and Health, American Cancer Society, American Heart Association, and Red Cross campaigns. There is considerable focus on environmental and ecological studies. The team pays particular attention to current issues relating to biology and incorporates those issues as much as possible. We have developed separate lab activities on drugs and cardiopulmonary resuscitation to add to our human anatomy and physiology unit and we subscribe to current periodicals, such as the **Morbidity and Mortality Weekly Report** to maintain relevant information on diseases affecting the population. Special consideration is given to the quality of life and how future generations can be affected by decisions being made presently. The air pollution and oil shale developments in Colorado are examples of areas where decisions are critical. We use the information on these areas as much as possible in the biology program.

## Facilities

Two of our classrooms are rectangular, encompassing an area of about 130 square meters. There are 15 lab tables per room arranged three across and five deep. Each room has two sinks, bulletin boards, chalk boards, display cabinets, cork strips around the entire room for displays of student work, ceiling hooks for display purposes, windows or a plant stand with light for plants, microscope cabinets, demonstration desk, and a refrigerator. Another classroom contains an area of about 200 square meters. There are thirty small desks in the center of the room. Peripheral lab stations serve twenty-four students, but the lab station area can accomodate up to twenty-eight students. In the lab station area, there are nine sinks and electrical outlets every 80 cm around the perimeter. Windows provide good lighting for plants. There are hooks in the ceiling from which plants and student work can be displayed. This room also has locking cupboards, student equipment boxes, two bulletin boards, chalk boards, a refrigerator, and cork strips around the entire room for displaying student projects. We also have a prep room that is used for the storage of lab equipment and for lab preparation. It contains a stove, sinks, autoclave, flammable material cabinet, cupboards, drawers, file cabinets and a telephone. Six teachers share a crowded, nonprivate office area. There are many distractions in this area which makes it difficult to have uninterrupted planning time or private conferences.

Since so many materials are shared, much time is saved because of the close proximity of the classrooms to the stockroom and preparation area. The room with the peripheral lab tables allows for lab materials to sit undisturbed during lecture. We successfully operated without this new room until three years ago, and still use two antiquated classrooms. We feel that good facilities are certainly an asset, but that outstanding programs can still be run in spite of physical setting.

In each room, we have audiovisual equipment such as film and overhead projectors. We have access to a lecture center which facilitates large group lecture sessions. We have developed items such as lab cards with recipes and lab set-up procedures which expedite actual lab preparation. We have two forms of our lab practical exams which each year need only minor revision. By teaming, we have been able to develop many forms of tests and assignments. In addition, it is very advantageous to have a large, well-equipped stockroom and a well-kept greenhouse. The central stockroom, or preparation room, is where basic materials are stored and prepared. Bio Lab Technicians (former students) are involved with lab setups and cleanups. During the actual lab, students have assigned stations in the room to facilitate distribution of materials. Every student is assigned a number for all lab equipment. This makes the student more accountable for materials and cleanup.

## Our Students

The students in our program are not specifically grouped according to ability levels, but General Science classes in Cherry Creek High School are designed for the lower level students. Our program is aimed at a wide range of students whose intelligence levels vary greatly. Most are highly motivated with a large percentage eventually heading for college. Cherry Creek High School participates in an extensive foreign exchange program, so our classes have had Spanish, Japanese, Vietnamese, German, Swedish and Korean students.

The number of students who take biology in Cherry Creek High School has increased at least 20 percent in the last five years. A large majority of these students go on to advanced classes. In fact, 69.4 percent of our school population have taken chemistry by the time they graduate from high school in comparison to a national average of only 16 percent. The percentage of graduates who have taken physics is 40.2 percent, whereas the national average is only nine percent.

Two thirds of the 681 students taking Biology I in 1981-1982 were involved in these team taught courses. Most of these students go on to higher level courses such as Physics, Chemistry, and Biology II. Almost 80 percent of the team's Biology I students do go on to Chemistry. Of those students who move on to advanced biology and take Advanced Placement Exams for college entrance, scores have been extremely high. Forty-six students have taken the Biology Advanced Placement tests in the last three years and have scored well:

AP grade of "5" - 47.8% of students (22 total)
AP grade of "4" - 36.9% of students (17 total)
AP grade of "3" - 15.3% of students ( 7 total)

Needless to say, these scores are a direct reflection on the high quality of basic biology education the students received at Cherry Creek High School.

The male/female ratio in science has been much more even in Cherry Creek High School than in most schools in the United States. In fact, the ratio has approached 50/50 in General Chemistry and Physics. This indicates our success in encouraging females in CCHS to pursue advanced classes in the sciences.

Each year, Cherry Creek High School has numerous entries in the Colorado State Science Fair. Many awards have been won, not only in the Colorado State Science Fair, but also in the Colorado-Wyoming Junior Academy of Science competition.

## What We Do

Cherry Creek High School has programs such as "Society and Technology Day" and "Nuclear Awareness Day" which maintain a flow of current, relative information. The team uses resources and speakers from the community for our lecture classes. Local resources such as the Denver Museum of Natural History, Denver Botanical Gardens or Denver Zoological Gardens are made into optional student assignments. Professional resource persons from the universities in the area have been helpful in their willingness to offer information and other contributions. The Denver University Open Clinic has been an integral part of our Drug Unit. They have come to the school to assist in facilitation of classroom discussions. Parents with special talents have also presented programs on violet propagation, fetal surgery, and cardiovascular surgery. Professionals in the area have presented programs to our classes on pregnancy testing. Nurses from Metro State College did a birth control mini-unit with our classes. Whenever possible, we try to utilize our community resources. We are fortunate to have Cherry Creek Dam State Recreational Area as a resource within walking distance of the school as well. It is an exceptional natural resource and an asset to our study of the short-grass prairie biome.

Parents are involved in several ways:

* Resources for speakers
* Fifty percent turnout at Back-to-School Night
* Parent-community involvement on school health and drug programs;
* Active Parent Senate
* Telephone communication on all absences from class on the day of the absence.

This program maximizes student freedom of choice in the pursuit of biological interests while still offering structure. The course allows for a wide range of abilities and interests. It cultivates self-reliance and individual initiative while teaching social concepts in team activities.

Our program has many optional assignments to individualize instruction and recognize student diversity. Progress Records (assignment sheets) are composed for each unit and are structured to meet the needs of students at many levels. The range of assignment variation might be as diverse as vocabulary, at one end of the spectrum, to wildlife art work, at the other end. An attempt is made to tap each student's forte. If a student is especially adept at writing, his choice might be a paper on a research topic. Or, if the student is artistically creative, there would be an option suited for utilizing that talent. Cooperation among students is another important aspect of our program. This theme is perpetuated through lab work as partners and in teams, collecting data for entire classes and using it for write-ups, and in group study sessions to answer test review sheets.

This program incorporates at least one assignment on each unit which goes beyond class time and structure. It requires self-motivation, self-direction, self-discipline, and creativity. This assignment can include an arts and crafts project, a visit to community resources such as the zoo, researching a topic related to the unit, or creating one's own assignment. Super learning techniques are also incorporated for rote memorization. These exercises are based on current studies related to brain hemispheres and learning techniques.

During a typical five-day period, a visitor might see students doing the following:

* Two lab sessions each week (100 minutes each)
* Taking notes to prepare for a lab
* Doing a lab activity or wrap-up
* Using audio-visual material, such as films, slides, filmstrips, VTR usage, etc.
* Taking a quiz or test
* Listening to one lecture session per week (as many as 4 classes combined at once--47 minutes)
* Participating in teacher-student conferences and help sessions
* Using library resources to research assignments
* Involved with student-student study sessions

## The Teaching Team

Teacher cooperation in problem solving is imperative due to the nature of our program. In a cohesive team-teaching situation, there are several characteristics which contribute to the success of the program. One of these characteristics includes the contribution of four individuals, each with his own area of expertise, to the entire curriculum. Rarely would one find an individual teacher who felt equally comfortable in all aspects of the biology curriculum. However, with four individuals the spectrum of expertise is broadened greatly. Labs, exams, and reading materials are subject to perusal by several individuals and multiple input makes the final edition more comprehensive. An individual teacher might have to go through several years of revision to feel the materials were in final form and ready for presentation to students. The expertise of several teachers not only contributes to the quality of materials, but also to the repertoire of the teachers who work together. More creativity in the final product is achieved in this manner. When a lecture is presented to a large group of students several times a day, the lecturer may have little enthusiasm by the fifth presentation. In a team situation, lectures can be alternated among teachers and one can achieve an enriched and enthusiastic approach to the topic.

The team approach to laboratory preparation affords a division of labor that can be both time and cost effective. If solutions have to be mixed for a lab, it requires very little time to multiply the amount by four and have the materials ready for 450 students. The initial time spent on planning a preparation is equal to what four individuals would have to spend if teaching on their own. Additionally, when exam, quiz or worksheet materials are being prepared by more than one teacher, it is feasible to prepare multiple versions of the materials. The cost-effectiveness of making materials for large numbers is evident, and waste is reduced as well.

Another characteristic which is beneficial to the students is the continuity achieved by making a team of teachers at their disposal. There is always a teacher available as a resource for questions regarding assignments. Students have the opportunity to receive assistance even if their teacher is in the middle of another class. The students also have the continuity of a class that will continue as planned if their teacher is ill or on emergency leave. Other members of the team assist the substitute with orientation to the materials and activities planned for that day, and the material is covered in a responsible fashion. In a team approach, the teachers also have the flexibility of taking a portion of another class if a teacher has an unexpected emergency and arrives late to school. On the other hand, if a student is ill, he has the added flexibility of making up the class with another teacher who is covering the same subject matter as was covered in the class missed.

Teaching strategies essential to the team program are:

* Organization--willingness to plan ahead, sometimes as much as a semester in advance;
* Dedication--to cooperation and to the time and effort required to do a good job;
* Willingness--to approach biology as a survey course of socially relevant issues based on a strong background of basic biological concepts;
* Cohesiveness-of philosophy within the team to work toward a common goal.

During a five-day period, a visitor would see teachers:

* Preparing and giving lectures
* Using audio-visual preparations
* Providing laboratory experiences
* Interacting with students, both in and out of class
* Interacting with teachers or administrators
* Evaluating student papers, quizzes, and exams
* Preparing and revising evaluative instruments
* Planning and brainstorming sessions with team members.

A teacher must have the self-discipline to see what needs to be done and the willingness to do it even if it is not a favorite task.

Teachers in this program need to have an excellent grasp of the subject matter, be able to plan and organize months in advance, be creative, be dedicated to doing the best job possible in spite of the time it takes, have enthusiasm, be self-confident, like to be with students, have a good grasp of professional ethics, be active in professional organizations, be involved in the community, and present a professional appearance both in manner and dress.

The teachers learned to use the program by working together on all phases of its development. The four team members have attended meetings and presented programs in Fort Collins for the Colorado Science Teachers Association for a district articulation day, NABT conventions, inservice workshops, and Colorado Biology Teacher's Association idea exchanges.

The team situation has shown itself to be cost-effective, therefore, funds, facilities and equipment can be put to more efficient use. When working with large numbers of students, there is less material waste during the course of a unit. The program would be applicable in any high school with a relatively large biology curriculum. The team program incurs no other expenses than those required by any good biology program. In fact, the team program is much more cost effective than four teachers working separately. The average cost per student per year is approximately $20.00.

## Curriculum Resources

**BSCS Green Version, Biological Science: An Ecological Approach** is the text used as a guide. It would be unrealistic to list the multitude of materials that we have used over the years to develop our program. We have devised data sheets, revised labs, and used team-developed handouts extensively. Although much of the academic material for the course comes from the BSCS Green Version, many special additional strategies and activities have been incorporated into the program. It would be difficult, if not impossible, for one teacher to offer so many options to students. Several specific examples are as follows:

* CPR, blood pressure, and cardiovascular labs
* Drug unit
* Urinalysis lab
* Metrics unit
* Improved blood and chromosome staining labs
* Reproduction decisions and responsibilities (birth control, abortion, and sexually transmitted diseases);
* Comparative ecosystem analysis of adjacent Colorado State Cherry Creek Reservoir Area;
* Colorado life zones slide show
* Optional visits to Denver's Museum of Natural History, Zoo, and Botanical Gardens;
* Optional computer assignments for units
* Bacteriology labs relating to everyday health
* Three or four forms of unit tests and quizzes
* Several forms of written assignments.

Other materials or resources that are important to our curriculum are:

* Computers: There are Apple computers in the Science Resource Center which are used to supplement some of the units.
  The team hopes to use more computer programs in the future.
  Some programs in use now are population

problems, unit vocabulary, quizzes, and genetics exams. These are programs that have been developed by our team.

- * Video Equipment:
  Video - The team has produced video tapes of laboratories, including fetal pig dissection.
  Films - The team uses relevant 16mm films through the district film library.
- * Speakers: Depending on the year and availability, the team has had speakers on the following topics: drugs, genetics, pediatric cardiovascular surgery, horticulture, otorhinolaryngology, and many aspects of human reproduction.
- * Resource Center: Contains books, periodicals and film strips which pertain to the subject matter.
  The resource center is a vital part of the individualized approach with a variation in requirements.
  The resource center presents opportunity for individual study in the depth desired by students meeting requirements or pursuing their particular interests.
  It enables the student to draw upon a wide range of references to gather different points of view and different approaches than used in the textbook.
  The center is available for student use at any time during the day.
  In Cherry Creek, the center is located separate from the classroom with a lay assistant present for help.
- * Greenhouse: Provides an environment for growing plants during our plant units.
  A variety of representatives of plant phyla for our taxonomy unit are maintained in the greenhouse.

No program can be taken verbatim, plugged into an existing curriculum and be successful without first evolving to fit the needs of that situation. Our curriculum sequence is designed to serve as an example from which an individualized program can be developed. Rather than provide an entire year's calendar with specifics, we are including a general calendar which can be reworked to serve the specific needs of an individual or team in a special setting.

| **Calendar of events for year:** | **Weeks** |
|---|---|
| Scientific techniques: metrics, microscope, etc. | 1 1/2 |
| Introduction to Ecology | 1 1/2 |
| Individuals, Populations, Comm. and Ecosystems | 3 |
| Plants: Introduction | 2 1/2 |
| Animals: Introduction | 3 |
| Protists and Disease | 3 |
| World Biomes and Paleoecosystems | 2 1/2 |
| Semester exams | 1 |
| | |
| The Cell | 2 1/2 |

| | |
|---|---|
| Plant Anatomy and Physiology | 3 |
| Animal Anatomy and Physiology | 4 |
| Mini Drug Unit | 1 |
| Reproduction | 2 1/2 |
| Genetics | 3 |
| Man's Biological Niche, Past & Present | 1 |
| Semester exam | 1 |

Throughout the course, we stress the continuity of evolution in all areas.

Our sequence of instruction is probably not unique. It works for us because it first looks at the whole, then it looks at individual pieces, and finally it puts it back together into one comprehensive whole. Our sequence builds throughout the year with concepts needing background saved for the latter part of the year. Lab blocks are scheduled 100 minutes twice each week and large group lecture is required for 47 minutes once a week. Students have the opportunity and are expected to attend an equivalent session if a lab or lecture is missed. With a team situation, there is the opportunity to attend equivalent lectures and labs during unscheduled time.

## Evaluation

In our program we strive to emphasize subject matter interest as motivation. Grades are deemphasized and students are given optional activities to reach the grade level they desire. The Cherry Creek program is based on an accumulation of points from required and optional activities. The desire is to give every student the opportunity to achieve the informational competence and grade level he desires without the necessity of leaping too difficult a linguistics hurdle.

In order to meet some of the goals given above, evaluation must be tailored to test knowledge of biological principles. Formal testing is de-emphasized. This is based upon two assumptions. First, biology as a science seeks to help students understand the nature of the scientific process and the work of the scientist. Scientists are problem solvers, equipment manipulators, data gatherers and analyzers, and users of the scientific method. Scientists are **not** test takers. Scientific concepts are reached by inquiry using the foregoing rather than by testing. Second, the emphasis is on attitude changes in the students, not on specific technical memorizations. Technical learnings do not comprise the major objectives of the courses. They are necessary as a prerequisite to the major objective, which is the development of new attitudes. Testing on subject matter can be used to determine these specific technical learnings. There is no satisfactory way to evaluate attitude development. Intuitive methods of evaluation and observation of behavior, which is correlated highly with certain desired attitudes, are the only ways available for such evaluation. Therefore, evaluations are always open to review and should be participated in by the student whenever possible.

Test review sheets are used. These contain all of the questions which will be used on the test. In Cherry Creek, a list of about 100 questions from which the unit test will be drawn is given each student. The desire is to make the test a teaching-learning experience. The test embodies the learnings of major importance in the subject matter. The use of review sheets, which the student knows will include all the information found on the test, encourages the study of concepts and, hopefully, remove the fear of testing present in so many test situations. The review sheet plus the test and the follow-up represent three highly motivated practices on the key subject matter material. Tests are given at the end of each unit. Cherry Creek tests are developed by our team of teachers.

Evaluation techniques we have used include:

- * Student feedback - formal and informal
- * Parent feedback
- * Peer feedback
- * Administrative feedback - formal and informal
- * Gut feeling.

We do not formally evaluate each other. However, if a team member sees a problem and has a suggestion, it is discussed and the change often implemented. In a team approach, respect and compatability are foremost.

We are continually modifying our evaluative instruments as weaknesses become apparent or as new needs, information, and materials arise. We are hoping to use our computer to generate several new forms of our final exam each year. One successful testing feature that we started three years ago is to give all make-up exams in essay form instead of the regular multiple-choice. This has promoted a high rate of attendance on exam days.

Constant updating of material and technique takes place as we grow as teachers and as we aquire new knowledge through additional course work, conferences, and professional involvement. Feedback from students is encouraged and considered in redesigning tests, labs, and organization of materials. Students are constantly involved in self-evaluation with the Progress Records. Each student is responsible for keeping a running total of his points which he should double check against the grade book. Each student is also given a class participation grade. He is asked to determine the number of points and then to give a rationale as to why he deserves that amount. The teacher then has the final word as to the number of points received for class participation. Some areas that are included in this grade are attendance, tardies, attitude, lab clean-up, and cooperation with lab partners.

Students are responsible for and held accountable for maintaining the condition of their assigned laboratory equipment and materials. They are responsible for the condition of everything from books to slides. Students are encouraged to choose from many optional assignments or to create their own assignments. Laboratory procedures also require decision making on the part of students.

Since there are four teachers involved in the program, as new issues come to the foreground they are incorporated into the program. We make these changes consistantly and constantly. When changes are indicated, assuming they are within our power and the budget, they are made. Changes we need that would enhance the program include more planning and lab preparation time. This additional time would allow us to improve on the quality and variety of available materials. Also, we need skeletons in each room, a typewriter and dishwasher in the storeroom, an incubator, more convenient accessibility to a large-group lecture area, and more file cabinets. Barring any drastic changes in team membership, budget, administrators, or community, the program will continue to evolve by responding to perceived needs. To facilitate positive evolution of the program, teachers should design the program to meet their needs. They should continually have an open mind and only use what works for them. Constructive criticism from students, peers, and administration should be considered with an open mind.

## SUPPORT

We are well-supported by the administration. At times we do wish there were more professional leave days available. We also need more advance notice of activities which interrupt classes. This would be of great value in planning and preparation. We would suggest a fixed activity calendar at least three months in advance. The school administration has provided release time and funding to teachers participating in professional growth experiences such as national conferences (NABT, NSTA) and local conferences. The administration encourages us to further our education by taking college classes, not only in our particular subject matter, but also in areas such as student psychology and study skills. The philosophy of the administration is to select the best people for the job and then stand back to allow them to do their jobs while keeping paperwork and meetings to a minimum.

Our science supervisor, Dan Van Gorp, sees biology as a survey course and encourages flexibility in terms of bringing in social issues, even if controversial. We have had his full backing in our team approach. Mr. Van Gorp also has encouraged and budgeted for our participation in local, state and national professional organizations.

The team does not require special support staff, but there are special people who make our job much easier. The secretary in the Science Resource Center assists students who are researching problems or working on assignments, gives make-up tests, types, takes telephone messages, checks orders and maintains the well-being of the entire department. Library Personnel help students with their research topics. School nurses are used for blood type labs and blood pressure screening. Also, they help teachers in researching topics and ordering audiovisual aids. We utilize the Consolidated Film Library which has available 16 mm films for the district. The Audiovisual Department staff supply and maintain overheads, film projectors, tape recorders and slide projectors for teachers' use. Handouts for distribution to students are run off by the personnel in the duplications department. The Custodial Staff maintain the rooms and take care of necessary repairs. Biological Laboratory Technical Assistants, with teacher supervision, are responsible for set-up of materials for student use, mixing solutions for labs, cleaning materials, grading exams and quizzes, and assisting in the greenhouse.

The community is important because they are very supportive of the entire school program. Parents are willing to participate if they have an area of expertise. However, teachers have been the critical element. Their cooperation, expertise, and dedication to the team effort have made it work.

Professional organizations, such as NSTA and NABT, have played a key role in developing and maintaining the team's program as it exists today. All four team members have been actively involved in both national and local professional organizations. Team members have held offices and worked on convention committees for these groups. These organizations have provided us with the opportunity to exchange ideas and information with other teachers and have given us a springboard for creativity. The team makes extensive use of many professional journals, including **The American Biology Teacher** and **Scientific American**. We are already involved in doing inservice for both elementary and secondary teachers in our district. Team members have given talks at professional meetings and local college classes as well.

If another teacher were interested in instituting this program in another school, we would first encourage them to visit our program and observe it in action. No program will work verbatim for a different teacher. We would encourage teachers to not take our program in its totality, but to rebuild it in their own image, giving it their character and redesigning it to meet the needs of their students and school community. Getting new teachers to use our program is not one of our major goals; we are not seeking converts. We are only seeking the best for ourselves and our students. It works for us. If all or part of our program will work for other teachers, then that is even more rewarding. The major reward is what the program does for our students and our community. Our program would fail without the constant dedication and cooperation of the teachers toward the team effort. The success of the program is not based on budget or facilities, but is based on the teacher's dedication and willingness to work toward the optimum biology program.

Teacher inservices, professional conferences, seminars, and idea exchanges are valuable for continual professional growth and program success. We probably have gleaned the most practical information out of "idea exchanges." The rewards for teaching are not material. They come from positive feedback from our students and peers, sometimes years later. An additional reward is the self-satisfaction of a job well done. We have all profited from attending teacher education workshops. Two of the team members became directly involved in BSCS this way. All team members continue to actively participate in workshops. The team sees workshops as a vital part in continuing and maintaining the social and subject matter relevance of our program.

The biology program stands on its own merits in that it is an elective course with 90 percent of the school population enrolled. The course is meaningful to the average student and a challenge to the gifted. We receive a great deal of support from the community and seek input from the parents when approaching controversial issues such as sex education, abortion, drug abuse, and creation versus evolution. The location of Metro Denver as the energy center of the western United States and its tremendous growth makes it a vibrant, challenging place to live; and the student population needs a comprehensive approach to social issues to meet that challenge. Cherry Creek High School is in an affluent section of that community and the biology program has to undergo constant change to prepare students for college and careers that lead to successful lives.

The team approach to biology has gone a long way toward fulfilling the objectives of Cherry Creek High School, namely, that of education excellence and preparation of students for life after high school. Students are guaranteed a well-rounded approach to biology through the group efforts of four biology teachers working together to produce the best possible program. Our current program has been responsible for helping all of us develop a willingness to share. It has given us the flexibility to see the merit in other approaches. In addition, it has aided us in developing a cohesiveness of philosophy that carries over into all of our everyday teaching.

# Chapter 4: LIMNOLOGY

By

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Located in central Florida, Lakeland is a city with a population of almost 50,000 people in an urban area of about 138,000. Growth has been rapid during the last ten years because of industrial expansion and the development of nearby tourist areas such as Disney World, Sea World, and Busch Gardens. Lakeland's major industries are citrus, phosphate, cattle, and tourism. These industries, which expanded rapidly in recent years, have now been hard-hit by the economic recession and have caused the county to have the highest unemployment rate in Florida.

Lakeland has exceptional cultural, medical, and educational programs for a city of its size. A beautiful Civic Center attracts quality performances, the Regional Medical Center and Watson Clinic are known throughout the state, and several colleges and universities are located either within the city or within easy driving distance.

Kathleen Senior High School, one of three public high schools in the greater Lakeland area, has a student population of 1,400 in grades ten through twelve. The majority of students come from the unincorporated areas and 86% live more than two miles from the school. Only 35% of Kathleen Senior High's graduates attend college, so the school attempts to offer a good balance of academic and vocational courses to meet the educational needs of its student population. Vocational programs are offered in five different subject areas and numerous college-preparatory courses are available including Advanced Placement classes in four subjects.

The parents and community are very supportive of the educational program and activities at Kathleen High School and Kathleen students are active participants in community activities. Kathleen Senior High strives to create an environment which challenges every student to develop his intellectual capacity to the fullest. Our goal is to provide the guidance and experiences necessary to stimulate all students to equip themselves to live successfully in a changing world.

## THE FOCUS: LOCAL RESEARCH

In 1970, I started an ecology class at our school; the first of its kind in Polk County. This semester course, designed as an elective for upper-level students, included units on air pollution, terrestrial ecology and aquatic ecology. In 1973, major emphasis was placed on terrestrial ecology and fresh water systems, since Polk county was experiencing rapid growth that was putting environmental pressure on our land and water resources. In addition, I received permission from the owner of a ten-acre wooded tract to use the area as a field laboratory in terrestrial ecology. Each year, from 1973 to 1977, a six-week unit on terrestrial ecology was conducted on this tract of land.

In-depth studies were made on soils, plants, and animals in the study area. The students even made a slide program of the plant and animal associations. In 1976, I discovered the land was for sale (zoned residential) and several attempts were made to obtain money to purchase the land to set up a permanent study area to be used by the school system. These attempts failed and the area is now a housing development. During this same period of time, I started our "Advanced Ecology Class," a second-year environmental class where students do independent research on environmental problems. Student research usually centered on water quality.

In 1977, when we lost our study area, the terrestrial unit was deleted from the class. At the same time, it was becoming evident to me that our surface water quality was deteriorating, so I began to increase the emphasis on this. The Advanced Ecology group was continuing to monitor six lakes within the city limits of Lakeland and this information was used in the regular Ecology class.

As I became aware of declining environmental quality in the area and students at Kathleen Senior High indicated they would be interested in elective science courses on a semester basis. The limnology sequence evolved as a result of this. Students contributed critical developmental input and student interest in the environment has been a major inspiration for the program. In addition, public awareness and interest in the program has been very encouraging.

In 1980, the course name was changed to General Limnology (formerly Ecology) and Advanced Limnology (formerly Advanced Ecology) due to the increased emphasis on fresh water. Since 1978, the "general" class has been a feeder to the "advanced" class. Since the mid-seventies, the Advanced Limnology program has been funded solely by the state Environmental Mini-Grant Program. This program supplies money for all reagents and equipment used by the students. The students in the program participate in the planning of the project through suggestions for new projects or new tests to be used in the existing program. Their planning input is also used during all programs requested by community groups. Students do all the work at these presentations.

The advanced class collects lake samples every other day and conducts a full range of chemical and physical tests. This data, permanently recorded, is used by our local newspaper in its quarterly "Environmental Newsletter" to the public. In addition, these students are very active in public awareness workshops on water quality.

The Limnology sequence at Kathleen Senior High is an elective for 11th and 12th grade students who have taken Biology and received a "C" or better. Students completing the General Limnology class with a "B" or better, are eligible for the Advanced Limnology class. Class size varies in the general class from 18 to 34. While class size in the advanced section ranges from 2 to 10. The general classes are semester courses. Currently, there are three sections scheduled. The advanced course is a yearly elective and has been maintained with one section per year.

## OUR GOALS

Our general goals are to prepare students for future problems resulting from today's society and technology by providing alternative methods of solving/living with these future problems. We hope to do this by:

* Developing an awareness of local and county-wide quality problems;

* Providing information relating to the causes of local and county water problems;

* Providing laboratory and field experiences in water quality evaluation;

* Enabling the student to predict future water quality based on laboratory and field measurement;

* Providing alternatives to present lake management techniques

* Demonstrating problems facing governments regarding lake management;

* Generating water quality data for the local news media

* Providing public awareness information on water quality

* Providing opportunities for public speaking.

The Limnology sequence is based on current water-related environmental problems in Central Florida. Social factors which may lead to our problems are discussed. In addition, there are discussions relating to the impact of our water problems on society and ways in which society can improve the situation.

## OUR PROGRAM

During the course, students are taught the various stages of lake aging. In addition, they are exposed to lake management techniques that may be used to restore or protect and preserve lakes. Students are asked to describe how society will have to adapt by changing attitudes and behaviors toward changing lake situations. The general curriculum includes air pollution, acid rain, ecological principles, hydrology of Central Florida, lake processes, lake problems, lake management techniques, lake management alternatives, water-born diseases, aquatic organisms, water chemistry, and a class study of ten area lakes on which students conduct analyses. Students study shoreline vegetation, common plankton, plankton density, and coliform bacteria. They also investigate settleable solids, color, turbidity, pH, dissolved oxygen, carbon dioxide, nitrates, phosphates, and Secchi disk visibility. The course ends with a three-day final exam during which students evaluate their data and write a report on the water quality of the lakes they studied during the semester.

The Limnology classes (both general and advanced) rely on data interpretation (they must evaluate the results of their water tests); chemistry (use of chemistry in water tests); math (calculations of concentrations based on titrations); social studies (man's cultural impact on water quality); law (who has the right to restrict what we do with our environment); art (drawings of plankton they find in water); and speech (making oral presentations in the community).

For 12 weeks, students are presented information relating to water quality. Chemical and biological tests are discussed and students are taught the significance of these tests as they relate to water quality. The last six weeks requires that students collect water from local lakes and evaluate biological and chemical factors. The final exam requires students to rely on their test data to evaluate local water quality.

After students have evaluated the local water quality, they are then asked to compare current data with data collected from previous years. From this they must determine if there is a trend toward improved or decreased water quality. They also project future water quality along with suggestions for local lake management. Students are asked to consider what type of water quality they can expect as adults and the type of water quality their children can expect if today's society continues its selfish abuse of water. And, students learn how their personal behavior can affect water quality.

I consider certain content as essential: the basic concepts of lake aging; identification of aquatic life forms; various chemical and biological tests for water quality and their significance; lab safety; lake management techniques; lake management alternatives. I emphasize the impact of today's society on our water quality.

Our water problems are a result of society and society is the result of human attitudes. Our aquatic environmental problems stem from human behavior. In solving these problems students use math, art, history, chemistry and biology. In the advanced level, students also rely on public speaking. Community relevance is expressed by local news media interest in the class, requests for public awareness presentations and the use of the Advanced Limnology class data for quarterly environmental reports by our newspaper. Local agencies involved with water quality and water management present programs on careers.

My teaching philosophy is centered around making education, science or otherwise, fun, interesting and significant. I attempt to implement this philosophy by using a variety of teaching techniques, getting to know my students personally, and by constantly looking for new materials which can be applied to local problems. Students work in lab groups and the instructor helps each group work out problems. Students often come in before and after school for help or extra work. Many class discussions center on local issues. Some discussions involve the role of the city and the public in improving water quality. Students test local water quality and relate it to their personal lake use and the public's lake use, both now and in the future.

In the General Limnology program, students essentially follow the course outline. In the advanced section, students are responsible for their own time and lab activities. They decide what needs to be done for the week and carry it out. During public awareness presentations, the students do all the organization, preparation and demonstrations. I, however do the evaluation, but I usually discuss with them how they felt about the presentation: Did they feel good aout it? Was it worthwhile? Did the audience remain attentive?

## A Typical Lesson Plan

Fresh Water Algae: Identification and Significance
Unit length: 2-3 weeks

Teacher activities
- Slide show of local algae
- Discussion of algae groups and their significance
- Students read "Algae and Their Significance"

Total - 4 days

Student activities
- Lab Algae slides (accompanies "Algae and Their Significance"). Students draw the algae and list name and significance.
- Lab - Live algae. Students draw from pure live cultures, label.

Total - 4 days

- Lab - Identification of Algae from School Pond. Students use previous training plus dittos on algae identification. They find the algae in their microscope, sketch, identify, and then call the instructor who signs his name to acceptable drawings. Each signature is worth 3 points.

Total - 5 days

## Limnology Sequence - General Overview

The advanced students complete the entire program. My part is to order the reagents and equipment and make spot evaluations of their progress. The students do all the data gathering and interpretations, recording, graphics, and housekeeping. The Advanced Limnology students also assist in teaching the general class, which is a good indication of their overall understanding of ecological principles.

This course could be established by any competent Biology instructor with an interest in ecology. Many literature references are available on the identification of fresh water plants and animals, and there are numerous articles in periodicals to use as supplemental reading.

The major strategy of the sequence is its community emphasis. The instructor uses many local professionals to introduce new topics, expand ideas, present opinions in contrast to the instructor's, and introduce career ideas.

Much of the success of this program is due to the general enthusiasm for teaching exhibited by the Biology teachers at Kathleen Senior High School. As they stimulate interest in science, it is possible to offer electives in specialized areas. In addition to student enthusiasm, there appears to be a good deal of community support for the program. This support has been demonstrated by requests for speakers and programs on water quality, the City of Lakeland's interest in improving lake water quality, the use of class generated data by the local news media, and financial support by local business.

The program is relatively easy to begin. Most Biology teachers have the background to identify the common algae, protozoa, and macrophytes associated with fresh water. There are many plant and animal identification booklets available for supplemental use. It is quite possible to use teacher-made microphotographs of local algae and zooplankton to add more meaningful learning situations.

By following local and regional environmental issues in the news media, it does not take long to build a "local environmental issues" library. From news media and environmental trends, the course content can be easily changed to meet current needs.

Cost factors are not prohibitive. A standard HACH environmental lab is available for about $600. After the initial cost, the program could be maintained for $200 to $300 a year for replacement chemicals. Local agencies or businesses may be able to offer grants or donations of equipment. The teacher's ambition and enthusiasm will determine the depth of content and variety of equipment.

## General Limnology Objectives

Students should be able to:

1. Chemically analyze fresh water for;
    - A. Oxygen
    - B. Carbon Dioxide
    - C. ph
    - D. Nitrate
    - E. Phosphate
    - F. Color
    - G. Turbidity
    - H. Secchi disk
2. Biologically analyze water for;
    - A. Biochemical oxygen demand
    - B. Algae density
    - C. Algae species
    - D. Coliform bacteria
3. Predict the relative safety of our local lakes for swimming, boating, and fishing;
4. Rank our lakes from dirtiest to cleanest;
5. Predict the future of our water quality based on current trends;
6. Suggest methods to improve local water quality.

Course Content includes:

1. Water testing procedures;
2. Algae identification and significance;
3. Analysis of local lakes;
4. Evaluation of water safety in local lakes;
5. Predictions of future trends based on current evidence;
6. Local hydrology;
7. Lake management techniques;

8. Final written report.

Pupil Evaluation is through:

1. Teacher-made tests;
2. Teacher-made quizzes;
3. Laboratory activities;
4. Final Exam-written report.

## Advanced Limnology Outline

Pupil Objectives--The student should be able to:

1. Conduct a scientific study on water quality;
2. Analyze the results and data collected in a scientific study;
3. Write a valid conclusion on water quality in the study lakes;
4. Make an oral presentation on local water quality from the data collected.

Course Content includes:

1. Application of limnology principles learned in General Limnology;
2. Monitoring six city lakes for water quality;
    - A. Dissolved oxygen
    - B. Carbon dioxide
    - C. pH
    - D. Nitrate
    - E. Phosphate
    - F. Plankton density
    - G. Secchi disk
    - H. Coliform bacteria
    - I. Turbidity
    - J. Color
3. Monitoring 8 county lakes for Lakeland Ledger "Environmental Report Card;"
4. Preparation of interim and annual reports on Lakeland lakes;
5. Preparation of data for presentation in Lakeland Ledger on county lakes (3 times a year).

Pupil Evaluation is through:

1. Subjective evaluation by teacher on student research;
2. Written reports;
3. Final summary of water quality.

Students leave campus to collect samples, then return and begin analysis. They are required to complete the following tests: dissolved oxygen, carbon dioxide, nitrate, phosphate, color, turbidity, secchi distr, coliform bacteria and plankton density. Over and over again, students gather water samples, test water samples, and record data.

I spend much of my time going around from lab group to lab group, lecturing, questioning, demonstrating, and testing. I use current newspaper and magazine articles from Science, Newsweek, Time, Omni, and

Science Digest. These materials are given out to students to read as resource materials. At the end of the course, they are collected for re-use. We have used outside speakers on many occasions. Some of our sources are: Florida Game and Fresh Water Fish Commission; Central Florida Regional Planning Council; Environmental Science and Engineering; City of Lakeland; and the Florida Department of Environmental Regulation.

The administration is very supportive in approving applications for grants to purchase equipment, seeking donations from industry to purchase equipment, assisting in scheduling, permitting students to leave campus for lake sampling, and encouraging field trips. Our science supervisor has been helpful as well. The community provides support through local newspaper coverage of class results, public awareness of program requests, and financial assistance. I think the relationship between the class and the community is very unique. The students are active in public awareness activities in the commmunity. By relying on local news media updates, we respond quickly to community changes and needs. I am a member of the Lakeland Advisory Board, so I can keep on top of city proposals and action concerning our lakes. The course content changes as the environmental problems of our area change. The basic philosophy is to educate the future citizens and taxpayers in environmental problems--what they are, why they exist, and what can be done about them.

My students have been featured in 10 different newspaper articles. In 1978, they helped the Central Florida Regional Planning Council on their Water Quality Management Plan. In 1980, three of the students were invited to Washington D.C. to meet President Carter and be recognized for their work in water quality. My students have given public awareness programs to the Sierra Club, Girl Scouts, Bluebirds, Brownies, and high school classes. Their data is published quarterly as a county environmental report card. Students have been featured in the HACH chemical company's newsletter.

I would like to be able to make more field trips with the classes to visit lakes. This would enable us to study the lakes in more detail. It would be more meaningful to students to be able to spend time at the lake instead of returning immediately after collecting the water samples. In addition, we need more class time to allow for more field trips.

I would like to see the program develop in other schools in Florida since our tourism industry and residential activities are so dependent on fresh water. I hope I will recieve requests for assistance in establishing the program from one or two schools. If more schools developed such a program, future voters will receive needed information on local water quality.

# Chapter 5: SUMMER MARINE BIOLOGY

by

**Phoebe Miller**

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Rockledge, a residential community of 20,000, has a middle class population of mixed ethnic background supported by light industry and citrus trade. A large percentage of the working class commute to the Kennedy Space Center and Patrick Air Force Base located about eighteen miles away on Florida's east coast. The general mood and climate of the growing community is excellent and very supportive of the school's educational efforts.

The school houses grades nine through twelve with an enrollment of approximately one thousand students and forty-eight teaching faculty members. The building is thirty years old and in constant need of repair but the atmosphere at the school is good, carrying a hint of anxiety due to the lack of funds to properly maintain the building and programs. Seven science teachers and eight science rooms comprise the science department at Rockledge High. Three of the rooms are equipped for laboratory use and one is used exclusively for science research projects. There is a greenhouse, but funds have not been available to repair it for use.

Biology and Marine Science with labs are both taught at the high school as they are throughout the district. Much of the instruction is textbook oriented, with a traditional classroom organization and atmosphere. While teachers are free to use supplementary materials, time seldom allows deviation from the essentials they are expected to cover. Teachers are mostly locked in to using the district adopted textbook and to following a standard progression pattern. The Indian River city dock, located four blocks away, is close enough for study, but walking a class to and from the site during the fifty-five minute period leaves little time for useful inquiry.

A few years ago, the pressing environmental problems and concern for human welfare and progress were only being talked about in the classroom. It was not a realistic situation. With the river, ocean, and ecologically productive mangrove area in such close proximity, it seemed logical to develop a hands on program in which students could become involved as participants in the discipline. But, there were too many problems in making such a program available. It was not feasible to include a field program during the regular school year so we incorporated it into our summer school.

I was inspired by a teacher in another school district who ran a summer environmental program on the west coast of Florida. Using this program as a model for setting up my program, I took a group of students and participated in one week's activities at the Marine Science Station in Crystal River, Florida. Pat Purcell, the station director, and Bill Kelsey, the resource teacher, were both invaluable guides during the set-up of the basis of the program. Their knowledge and ideas were incorporated into the program we designed. As a result of this, we wanted students participating in this program to develop:

- Improved problem solving and decision making skills
- Knowledge of the scientific principles and processes of life and use the knowledge to benefit the quality of life;
- An awareness of current social issues dealing with science and the environment;
- Attitudes which result in the acceptance of responsibilities to wisely manage the total environment;
- An appreciation of science related careers.

Several factors were involved in developing the program:

- Approval by high school administration
- Approval by county school administration
- Developing a curriculum
- Transportation to and from the location
- Choosing students to participate in the program
- Funding the program.

Approval by my high school administration was readily obtained as they were aware of the need for a hands on approach in this area. In order to get the county approval it was necessary to develop an outline including course description, objectives, requirements, schedule, and projected enrollment. Since the program was open to all high school students in Brevard County, school bus transportation was supplied by the school district. The first two summers, 1979, 1980, and the fourth summer, 1982, the program was located at the Crystal River Marine Science Station on the west coast of Florida. Situated at the confluence of the Salt and Crystal Rivers, the field station is composed of two dorms, a lunch room, library, and two laboratories. Boats are available to carry participants to a variety of areas ranging from 15 miles into the Gulf of Mexico to the headwaters of the river, beginning at a 35 foot deep crystal spring. The Crystal River program is designed for one week of concentrated study with students supervised for twenty-four hours daily.

One of the most important aspects of the development of the program has been funding. The cost of $180 per student at Crystal River was prohibitive and excluded many deserving students. In order to reduce the individual's expenses, community assistance was enlisted. Letters were written to local clubs, service organizations, and business establishments explaining the program and future goals. Requests for partial or full sponsors for individual students were generously granted.

In our school system, students are normally phased according to their ability in most academic classes. However, in our summer science program, they are not classified according to ability levels. The course is open to all students including exceptional education students who often excel in a hands-on program. Certain students with physical handicaps may not be eligible to participate in the program, since all participants must be able to swim, to maneuver in and out of boats, and on rocky or overgrown areas. Students must be able to follow directions with precision.

## OUR PROGRAM

Environmental Marine Science is offered by Rockledge High School during the summer session and is open to all students in Brevard County who will be in grades nine through twelve the following school year. The program is designed to give students hands-on experience in the fields of marine biology, ecology and the environmental sciences in one or two weeks of concentrated study. The students are transported to the Marine Science Station in Crystal River on the west coast of Florida or to a Girl Scout Camp in Merritt Island on the east coast of Florida. Both are in an estuarine locale and are similar in their housing arrangements.

The objectives vary from summer to summer due to changes in location and to meet the needs of the particular group involved, but basically they are as follows:

* Permit students to become involved as participants in the discipline;

* Develop attitudes which result in the acceptance of responsibilities to wisely manage the environment;

* Pursue activities that will develop knowledge/skills including the
  --examination of mangroves and associated organisms to understand detritus based food webs
  --recognition and analysis of beach characteristics
  --analysis of sea water and bio-chemical surveys of aquatic ecosystems
  --operation and use of plankton nets and seines for collection purposes and population counts
  --study of anatomy and behavior of marine sponges, coelenterates, mollusks and arthropods
  --collection and preparation of herbarium mounts of marine algae
  --observation and analysis of zonation in marine environments
  --identification and behavior studies of coastal birds
  --basic understanding of meteorology.

The curriculum, based on the objectives, includes daily field activities, laboratory activities, movies, and lectures on taxonomy, limnology, oceanography, ecology, and meteorology. In addition, guest speakers from the community present programs on special interest topics, such as the manatee, dolphins, Florida's endangered species, ecology of a salt marsh, the pollution of our water, and other socially relevant environmental issues.

Field activities include boat trips to:

**Sponge beds.** Students swim in areas having different sponges, corals algae and fish. **Oyster bars.** Students examine population and habitat during low tide. **Mangrove islands.** Students collect by screen sieve and shovels in nearby mud flats. They also observe water foul that nest in mangrove rookeries, and study the ecological succession of an island. **Deepwater drag areas.** Students drag sandy bottom areas with otter trawl to gather biota for later identification and study in the lab. They also have a plankton drag in these areas. **Freshwater springs.** Students swim and snorkle in areas to compare freshwater flora and fauna with previous marine observations. **Artificial reef.** Students study reef succession in deepwater areas where old tires have been anchored on bottom. **Various stops between marine and freshwater areas.** Students run tests on water samples taken from deep marine water to fresh spring water. They also compare changes in flora and fauna both in and around water as the water changes from salt to fresh.

Other activities include:

**Ecology hike.** Students observe and identify local flora and fauna locate around the station or lodge. **Development of nature trail.** Students clear trail through wooded area and make signs identifying various plants. **Algae press.** Students learn preservation techniques for aquatic plants and algae. **Canoe hikes.** Students take canoes through shallow water tidal canals for observation and ecological interpretation of flora and fauna. **Museum trip.** Visit Indian Museum and tour area where Indians lived.

In the laboratory students examine various biota that are collected during the day, often doing extensive research on a particular species. They also work in small groups on projects related to the course activities. These projects are presented on the last day of the course.

The instruction for this program is greatly supplemented by members of the community having expertise in various areas. Guest speakers are solicited from the local museums, the community college and nearby university, the Audubon Society, the Kennedy Space Center, the National Wildlife Refuge, the Florida Game and Fresh Water Commission, the Mosquito Control District, the Department of Environmental Health, the Department of Water Resource, the diving school, and the Marine Science Station personnel.

During the following school year, the students are often invited to speak to various groups that have sponsored them, such as garden clubs, boating clubs, and professional organizations. They usually present slides of the various activities and then discuss the problems that they personally feel are critical to the situation. Community response to these student speakers is overwhelmingly favorable.

The students probably saw more of an immediate result of society's impact on the environment at Riverpoint where pollution problems prevented them from getting into the water and fish kills were a common sight. Several students, by canvassing the neighborhood, expressing their views and asking for community support, became involved in the local fight to stop the dumping of sewage.

# HISTORY

This program has been in existence for four summers. It was designed to supplement the present classroom biology situation by combining the school curriculum with actual experience in the outdoors.

The first two summers, 1979 and 1980, the program was located at the Crystal River Marine Science Station on the west coast of Florida. The station is situated at the confluence of the Salt and Crystal Rivers. It is composed of two dorms, a lunch room, library, and two laboratories. The laboratories are equipped with compound and dissecting microscopes, dissecting equipment, and large tanks for live aquatic organisms. Boats are available to carry participants to a variety of areas ranging from 15 miles into the Gulf of Mexico to the headwaters of the river which begins at a 35 foot deep crystal clear spring. The Crystal River program is designed for one week of concentrated study with students under supervision for twenty-four hours daily.

The station is staffed by the project director, resource teacher, boat operator, custodian, secretary and food service personnel. The cost of the program, $180 per person, covers all expenses, but is beyond the means of most of the students. To defray the cost, fundraising projects were held during the school year and community organizations were asked to either fully or partially sponsor a student. As a result, more than half of the students received financial assistance from the community.

After two summers of traveling to the west coast, the opportunity arose to develop a program in our own community. The Girl Scouts acquired twenty-five acres on Merritt Island and wanted to set it up as an environmental science station. The property is bounded on the west side by Newfound Harbor and on the east side by the Banana River. The Atlantic Ocean is about two miles east of the Banana River. The area called Riverpoint, has a lodge that accommodates thirty-six people and a large dock. Other than the living facilities, all other equipment had to be obtained. Again, the community was asked to help, not only with the financial development of the program, but also with speakers having expertise on various environmental subjects. The response from the community was successful and, from that point of view, so was the program. Unfortunately, the surrounding water was so polluted that the students were unable to swim or collect many marine specimens. They did develop the land trails, run bio-chemical surveys on the ecosystem, and analyze the water four times daily.

The only personnel provided by the Girl Scouts was a full time ranger/caretaker living on the premises. Therefore, a second instructor, trained in water safety, and a volunteer cook were added to supplement the biology teacher.

The Riverpoint program was designed for two weeks with classes held Monday through Friday from 7:30 a.m. to 4:00 p.m. Each Thursday involved an overnight stay in the lodge. Bus transportation was provided from Rockledge High to Riverpoint and back each day. There was a $10 charge for lab fees and food for the two evening and morning meals. Other meals were furnished by the students with milk and juice available for purchase.

The fourth summer, 1982, the students requested a return to the Crystal River area with the addition of SCUBA diving to the curriculum. This involved an additional instructor certified to teach diving, and an additional week for confined water instruction, held at Rockledge High

School, an additional $50 to cover the cost of air, use of equipment, and instructional fees, and an additional half credit in physical education. The activities during the last session were similar to the first two summers, but more emphasis was placed on the aquatic organisms, as there was more of an opportunity to observe them with the scuba gear. The field activities also included three check-out dives, one in the gulf and two in the springs.

## FACTORS CONTRIBUTING TO SUCCESS

Several factors contribute to the success of this program. One is community involvement. Without the assistance and encouragement from the community, it would have been impossible to fulfill the objectives. A second factor is a supportive school system and a cooperative administration. The school provided the transportation all four summers and the miscellaneous small equipment necessary for the program. The administration took the time and interest to answer questions both from the parents and community organizations. Another factor would be the people involved. The guest speakers, teachers, even boat drivers and caretakers, are enthusiastic, knowledgeable, interested individuals who make the program not only a great learning situation, but also an experience that the student enjoys.

The same factors that contribute to the success of the program are needed to keep it going. This program could be successful anywhere. It could be geared toward any environmental community from a desert to a forest. Learning can be fun! The program is such a stimulating, exciting experience that the teacher becomes an enthusiastic leader and learner. Many of the experiences, particularly those under water, are a first for the teacher as well as the students.

This program's unique feature is the fact that it is almost totally conducted in the natural habitat of the organisms studied. The classroom is the outdoors. Additional facilities include a room designed for laboratory, audiovisual, and lecture use. This room is equipped with several holding tanks for keeping the live specimens collected during the day as well as preserved and mounted specimens representative of those found in the area.

Necessary equipment includes outboard motor boats and canoes and collection gear such as plankton nets, trawls and seines. Materials, chemicals, and equipment are stored in the laboratory and supply building. They are available for student use with the understanding that everything is cleaned and stored after use.

Students are a part of the discipline. Although certain activities may be planned, the traditional view of planning lessons, evaluation, classroom management etc., are absent in this program. The content covered and ideas discussed are completely flexible depending on what natural interactions are observed each day. Each day's activities are similar in schedule. A typical schedule is as follows:

| | |
|---|---|
| 7 a.m. | morning call and breakfast |
| 8 a.m.-9 a.m. | lecture and preview of day's activities |
| 9 a.m.-12 noon | field activities |
| 12 noon | midday meal |
| 1 p.m.-4:30 p.m. | field activities |
| 5 p.m. | evening meal |

| | |
|---|---|
| 6 p.m.-8 p.m. | lecture/lab activities |
| 8 p.m.-9:30 p.m. | guest speaker |
| 10 p.m.-11 p.m. | lab activities |
| 11:30 p.m. | lights out |

During the course of field activities, lab activities and lectures, students observe the environment in its current state, determine its past history and the changes that have occurred up to the present, and address society's role regarding the future. Students are exposed to the biotic and abiotic environment, examining the interrelationship of the two, its effect on human life and the effect of human life on the environment. The essential aspect of this program is to develop an appreciation of the natural world and the desire to live in harmony with it.

Students are encouraged to seek solutions to environmental problems that would benefit both humans and the environment. Social issues such as dumping treated sewage in the river, stripping the islands to build condominiums and motels, and filling in the marsh lands for waterfront subdivisions are debated. The rights of boaters, fishermen, businessmen, homeowners, and vactioning tourists are looked at from legal, economic, and moral standpoints.

The students are encouraged to determine the niche of various organisms as they observe them in their natural habitat and what their community future would be if the organisms were elminated. By using the inquiry process, they often come up with conflicting viewpoints which further enlighten the discussions by introducing the pros and cons that exist in every situation. These discussions may lead to a need to know the legal ramifications of certain situations. Often, this requires students to research the applicable laws and regulations.

During the field work, as a result of visits from guest speakers, and from the audiovisual materials used, the students are vividly confronted with the many professions that are involved in managing the environment and the career opportunities that are available to them.

Students are exposed to the actual results of society's impact on the environment at Riverpoint where pollution problems prevented them from getting into the water and fish kills were a common site. Several students, by canvassing the neighborhood, expressing their views and asking for community support, became involved in the local fight to stop the dumping of sewage.

The curriculum was developed specifically to gain knowledge by observing nature, and to assimilate the information in order to solve problems and make wise decisions. The curriculum remains flexible to deal with the various cultural and scientific problems that may arise each year. The program emphasizes the role of humans and the responsibilities that each one has to improve the quality of life for all humans and still live in harmony with nature.

Basic instructions are of a general nature for overall information, but during field work the instruction becomes almost totally personalized on a one-on-one basis. Laboratory work is all individual and the amount and type of research completed by each student depends on individual ability. Cooperative team work is absolutely necessary in field activities as the buddy system is used continously. Also, group projects are developed and presented at the end of each session. As I have mentioned before, daily lessons are totally flexible and are often determined by weather, student needs, and the naturally occurring incidents of the day. The teacher has most of the input into the planning of these lessons, but often student generated topics are included. Teacher and students together evaluate the student, the program and the teacher. Part of the summary report includes these evaluations. Laboratory materials are prepared almost totally by students, although the teacher is responsible for making the materials available. Instruction is shared by the teacher, guest speakers, and various members of the support staff. Teachers must be flexible, enthusiastic, highly motivated and knowledgeable. Teachers avoid following traditional classroom procedures. With the exception of general instructions and various lectures, the teacher is involved in the same activities as the students.

Textbooks are not used. Library resources, field guides, and teacher-made handouts such as maps of a particular island or check sheets for water analysis are used extensively.

## EVALUATION

The students are given a pre-test and a post-test to assess the knowledge gained. No other written test is administered. Teacher observations during field activities, laboratory investigations, group project demonstrations, discussions, and research reports are used to evaluate individuals. In order to receive one-half elective credit in science for the course, a student must satisfactorily meet the following requirements:

* Maintain a daily log
* Participate in the field and lab activities
* Write a summary report
* Present a group project
* Take pre-test and post-test.

The student has the opportunity to continue studying upon returning to Rockledge for an additional half credit. The student must choose a topic relative to the environment, do further research in the library, and write a research term paper on their findings. The program is evaluated by the success of the students in later high school or college science courses, by the attitudes towards the quality of life developed by the students, and by the number of students who have heard about the program from past students and asked to be included in the next summer's course. Also, community reaction following the student reports to sponsoring organizations is an important evaluation measure. The most notable measurable achievement of the student's progress in the program is a 60 to 90 percent increase in knowledge on the post-test. The change in attitude that occurs is not as easy to measure. This becomes evident in their summary reports and their presentations to the community sponsors. Selected students give a slide program and talk to those community organizations that request a follow-up report. They present slides of the various activities and then discuss the problems that they personally feel are critical to the situation. Community response to these student speakers is overwhelmingly favorable.

The overall philosophy of this special program is naturally carried back into the regular classroom situation. As textbook material is covered, experiences and observations from the previous summer's program are constantly being introduced into the discussions. Cost of transportation to and from the study area is paid for by the school district. Student cost ranges from $10 to $210 per student depending on the study area and options chosen. Professional organizations provide our staff with inspiration and **The Science Teacher** is used extensively. I am presently using an article "Class, Open Your Computer," November 1982, to develop an Educational Improvement Grant and to stimulate discussion in advance classes and with research students. Depending on the location of the program, special support staff may include the station director, resource teacher, boat operator, custodian, water safety instructor, and cook.

Long term goals for our evolution include a permanently staffed environmental learning center that all schools in the district could use. Programs would be designed to accommodate elementary, middle, and secondary schools both in marine and terrestrial ecology. The center could be used on a daily or a weekly basis. As it is now, all organizational activities must be done during during the regular school year. The program would be enhanced if I had more time for organizing, writing letters, and developing new activities.

If I had the opportunity to hold an inservice for teachers, I would basically have them do the same activities as the students. This program is such a stimulating, exciting experience that dedicated teachers would be so highly motivated they would grasp the procedures immediately. I think the program will be picked up by other teachers in the district and more schools will become involved. When this happens, the county administration will be more inclined to provide funds for developing a district wide facility.

The most encouraging support the administration could provide would be by developing a permanent, local, environmental learning center for all schools to use. Money for the development of such an environmental center needs to be a high priority.

It takes a considerable amount of time and patience to organize and set up the program. It is well worth the time and effort involved. Teachers involved in the program have received school board recognition for outstanding service. In addition, they have received recognition from the Florida Association of Science Teachers. We have a good program for students and I have no doubt it will continue to become even more interesting and valuable to students.

# Chapter 6: STONES AND BONES

By

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Los Angeles Unified School District, with 737 schools and 651,000 students, is the second largest school district in the nation and currently increasing in population. Although the Los Angeles Unified School District is decentralized, allowing for instructional decision making at the local school level, there are curriculum guidelines used on a District-wide basis. Even so, teachers have considerble freedom in their selection of instructional materials.

Stones and Bones, designed for all academic levels, was developed after an extensive needs assessment was conducted on a local and national basis. We wanted to include a study of humans as part of our science, but the little anthropology in current biology textbooks reflected a very didactic, superficial, non-interdisciplinary approach to the study. Anthropology texts assumed a semester or year-long course. We wanted to develop physical anthropology units for three settings:

* Biology, a four to six week unit;

* General science, a four to six week unit;

* Semester Course.

Dr. Sid Sitkoff, one of two science specialists, initiated the program and served to direct its development and operation from its inception to the present. The program was developed during a three year period with ESEA Title IV-C funds and pilot tested in sixteen high schools. Complete implementation of the new program has occurred because individual schools have requested it. So, the change to the new program was very simple to implement and very cost effective. The change took little time or training.

Teachers, selected on a voluntary basis from 12 public and 2 private senior high schools in 1977 for field testing of the original program, learned to use the program materials by attending staff development training workshops. These workshops, headed by Dr. Clark Howell and other internationally recognized anthropologists, provided instruction in the use of various project developed instructional media, instructional strategies, and general background information. Other follow-up workshops by project staff and experienced teacher leaders were held frequently to update the progress of the program. Periodic in-service workshops were conducted as needs arose.

The inspiration for Stones and Bones came from teachers and students declaring their interests and needs for an anthropology program. Since the present Director of Stones and Bones had a working relationship with a trustee of the L.S.B. Leakey Foundation and the Director of the Los Angeles County Museum of Natural History it was natural that they would work together to develop the program.

From the very onset, the Stones and Bones project has received enthusiastic support from the Leakey Foundation. They have provided us with their knowledge and expertise in the areas of physical anthropology, volunteers for fossil replica castings, and contacts with world recognized anthropologists. The Los Angeles County Museum of Natural History has provided their staff, facilities, and expertise. The Los Angeles Board of Education and the Superintendent approved and supported the program from the beginning. The classroom teachers who expressed the need for such a program and their input, evaluation, development, support, and implementation during the experimental period were invaluable to the evolution of the program that is used today.

As we developed curriculum materials, we included printed student materials, cast fossil replicas, printed teacher materials, and other supplemental instructional materials. We also designed staff development training workshops. Instructional materials were continuously received and revised during the three years of development. The involvement and support of the Leakey Foundation, the Los Angeles County Museum of Natural History, and an independent evaluator for the project were critical and highly valued.

## THE PROGRAM

Stones and Bones has been adopted or adapted by schools in many geographical areas in California. From urban schools to rural schools, from San Diego in the south to Los Molinois in central northern California, the program, with its three instructional pathways, is being used to meet the needs of students of all ability levels. No known problems with handicapped students, low ability or gifted have been reported to date. A wide range of socio-economic status is represented by students in the program as well. The nature and the format of the Stones and Bones program is such that students view the program as both stimulating and motivating but not imposing upon them ideologically. Students maintain their freedom to adopt a personally comfortable view of the changes in humankind over time. In the five years the program has been in operation, no complaints about the curriculum contents or approach have been received from school administrators, parents, religious organizations, or students.

The content emphasizes physical anthropology within an interdisciplinary approach to other areas including cultural anthropology, biology, physiology, anatomy, math, geography, and geology. The philosophical position of Stones and Bones focuses on the study of humankind. This concept pervades all instructional materials providing students and teachers with a better understanding of themselves and the world in which they live.

The Stones and Bones program emphasizes the concept of adaptation relative to the study of humankind through the years. This is a very important aspect of our ability to survive and progress. By studying the past in the program, students have a better perception of the future and their own self-image. Stones and Bones has a close relationship to social concepts in the social studies field, particularly cultural anthropology and behavioral science.

The project is very inquiry and process oriented with specific science and learning skills emphasized in every student's investigative activity. Scientific methods are applied in a problem-solving approach to learning. Students use these science processes (skill and knowledge) and apply them to human behavior and environmental settings. Students investigate, gather data, and come to their own conclusion based upon present evidence. Additional assignments, such as research reports, are done cooperatively by teams and their final report is presented to the class as a whole.

Students are actively participating in the entire curriculum. The investigative laboratory approach involves the students in every phase of identifying and solving problems. They develop skills in gathering, sharing, discussing, and evaluating data based on their investigations. As a result, they may plan additional research strategies for updating and reporting their findings to the class.

During any period of time, observers of the Stones and Bones program will see students of various ethnic groups from widely different socio-economic levels working together. Various assignments are made to leaders of each cluster group to monitor such things as distribution and collection of laboratory materials, clean up and securing of materials, acting as moderator in group decision making, and serving as liaison person among the cluster groups and teacher. In all three instructional pathways, students use project developed materials including Student Laboratory Explorations, data worksheets, fossil replicas, and study prints in their pursuit of problems. They gather data from evidences presented and analyze, hypothesize, discuss and draw conclusions based on their findings. Student workers can also be seen replicating fossil casts at the Science Production Center.

Stones and Bones requires active student participation throughout the exploration from the introduction of the topic through identification of the problem, collecting of data, analyzing of data, hypothesizing, testing and experimenting, and drawing conclusions and/or creating new questions and problems. The subject matter lends itself to an interdisciplinary approach so that basic skills and concepts in many areas are constantly being reinforced.

Students are encouraged through successful academic experiences in Stones and Bones to pursue a more academic program for career training, Students are continuously exposed to various interrelated careers through the interdisciplinary nature of the program.

Stones and Bones requires no more than a regular classroom setting. We prefer student tables in clusters with each cluster providing seating space for six students. Cluster arrangements provide adequate space for a team approach to the explorations and emphasize cooperation. Bulletin boards are used for current anthropological news and class progress charts. Fossil replica casts are displayed in display cases when not in use.

Very problem-centered and flexible, the program can be used with entire classes, groups of students or individualized study. The entire program is a new and innovative approach to the study of physical anthropology. All printed instructional materials and other instructional media were developed and culturally and scientifically validated by the project. Fossil replica casts, validated for accuracy and authenticity, are cast by the project and play an important integral role in the study of humankind. Replicas of this quality and low cost are not available anywhere else.

In addition to project developed instructional materials, other resources such as class visitations to a zoo, local archeological dig site, and to local museums can supplement the curriculum. These field trips can precede the activity to which they are related. For example, zoo visits with pre- and post-visit plans can enhance and supplement the exploration of primate behavior. Selected films and videotapes can be used to introduce and reinforce particular explorations. Guest speakers in their specific area of expertise enhance the overall program.

## CURRICULUM SETTINGS

The program offers three separate instructional approaches designed for varying ability levels from the nonacademic to highly academic students.

The **Biology Unit** is a four to six week overview of physical anthropology providing students with materials and activities as an enriched supplement to the presentation of anthropology by their biology textbook. A series of eleven student laboratory explorations focus on topics including primate behavior and distribution, interpreting the archeological record, primate locomotion and morphology, and early hominids. Fossil specimens are cast and made available especially for the program. This approach reinforces and extends many basic concepts taught in the study of biology. Unique features of the biology unit, in addition to other media materials, are a syllabus, illustrated study dictionary, and visual aids showing the progress of the class in a bulletin board display.

The **Modern (General) Science Unit** is specially designed to motivate non-college oriented students. Each of the 20 laboratory explorations offers the general science student opportunities to investigate topics including the geologic time table, measuring radioactivity, locating points on a map, behavior of primates, and fossil hominids. Each of the explorations has a glossary, vocabulary drill or word puzzle. The student reading series of booklets on special topics in physical anthropology are illustrated and written in a narrative-style, simplified format with lowered readability. During the four to six week unit, students simulate excavation of specimens through the use of tools provided in the fossil dig classroom kit.

The **Semester Course** in physical anthropology provides students with the opportunity to study the story of humankind in-depth. Laboratory investigations pursue such topics as: phylogeny through time, continental drift, locomotion and behavior of primates, primate classification and morphology, Australopithecus, Neanderthal, Homo erectus and Cro-Magnon. Many supplementary instructional materials for students and teachers are available including study prints, charts, a filmstrip, and fossil photograph set. This in-depth approach to the study of humankind provides an enriched academic experience in science and may be related to existing classes in cultural anthropology.

The calendar of events for the entire school year reflects the participating school's regular science curriculum. Stones and Bones fits within the ongoing science program. Specifically, the Biology pathway becomes a part of the regular Biology program. Similarly, the Modern (General) Science pathway becomes a part of the Modern (General)/Life Science course. The Anthropology Semester Course is taught during a one semester period and may become a semester part of a year program when taught in conjunction with Cultural Anthropology, Physiology, or any other related science course.

We use community resources such as the L.S.B. Leakey Foundation and scientific staff at local universities as students study themselves in relation to early humankind. They also study the variability and similarities within groups.

Since students are extremely interested in learning more about early and present humankind and themselves. Stones and Bones has strong relevance for students, teachers, and the community, and leads to more awareness of human roots.

The program's approach continually involves students in decision-making conducted by the students themselves or by the teacher. The teacher also acquires a better understanding of humankind, past and present, regarding structures and functions, adaptation, behavior, and survival. The future is analyzed regarding humankind's development and welfare.

## INSTRUCTIONAL STRATEGIES

Instructional methodology directly involves students in laboratory investigations emphasizing science, anthropology, and mathematics. Processes such as questioning, observing, hypothesizing, investigating, reading, discussing, listening, recording information, summarizing, and conceptualizing are used. Teachers encourage student learning in a problem solving oriented classroom environment. All three instructional pathways can be used with an entire class, learning centers, or other individualized strategies. The instructional materials have been designed for use by students of various ability levels. The availability of multimedia materials further provides for individualization of instruction. It should be noted that all instructional materials have been validated by the L.S.B. Leakey Foundation, Los Angeles County Museum of Natural History, and Dr. Clark Howell, Chairman, Anthropology Department, University of California at Berkeley, as well as other internationally recognized anthropologists.

The teacher's role varies depending on the activity. Minimal planning will be needed for the majority of the explorations although some materials must be prepared a few days in advance. Stones and Bones by design requires minimal preparation for laboratory materials. Most materials needed are common and those instructional materials produced by the project can be readily stored in a central location. The teacher's role in instruction is non-directive in that student explorations are highly self-directed and teachers serve as a "guide" through the explorations. Teachers provide activities, ask probing questions, and encourage students by listening and observing them. Students see these classes as stimulating. A short introductory discussion is recommended prior to the explorations.

Teaching strategies depend on class size. In large classes teachers usually make a few introductory statements and then serve as a guide in class discussions concerning the problem. Later, they may break the class up into cluster groups of four or five students to investigate, observe, record, conclude, and report. Each cluster group, through their group speaker, reports their findings to the class as a whole. The teacher tries to draw a consensus while at the same time allowing individual conclusions and reports. Minimum teacher lecture format should be observed.

Throughout the Stones and Bones program, the teacher's role is basically to guide the students through the explorations. During any five-day period, a visitor will observe the teacher teaching one of the three instructional pathways by serving as a moderator/guide in class and cluster discussions, aiding and encouraging individual students in areas of difficulty (math calculations, terminology or manipulation of equipment), supervising the distribution and return of materials, evaluating lab reports, and administering examinations. At certain scheduled times, teachers can be observed participating in anthropology workshops as well.

Stones and Bones is an activity, "hands-on" oriented program that is highly student self-directed. The individual student investigative, manipulative approach is most effective, therefore, long extended lectures by the teacher are avoided.

Our program is based on developmental psychology and higher cognitive levels are continuously emphasized in their relationship to the affective and psychomotor domains. Teachers implementing Stones and Bones program have expressed positive responses about their students' involvement with "hands-on" laboratory explorations. Statistical data confirmed teachers' comments that the program has contributed substantially to student achievement in science. Due to of the highly self-directed nature of the program, teachers feel comfortable with Stones and Bones. The success of the program is not contingent upon teachers with highly specific backgrounds nor does the program require extensive training for its implementation. It should be noted that all teachers involved in teaching the program during the past five years have elected to continue teaching the program in their classrooms. Teachers evaluate students by observing laboratory activities and grading written laboratory reports, teacher developed unit quizzes and tests. In some instances, word games and puzzles are used as an evaluation device. The overall program is evaluated with project developed and criterion referenced pre- and post-tests. Student opinion survey forms are also used to evaluate the overal program, teacher, and students.

## EVALUATION

Teacher evaluation of student achievement includes: pre- and post-test results, observation of student participation, student record information on project developed data worksheets, student discussions of class activities, and records of teacher developed quizzes and tests.

The evaluation approach in the program provides students with information relative to their own personal academic achievements and understanding of human problems and issues.

Students involved in the Stones and Bones program evidence exceptional achievement as indicated in the evaluation report prepared by an outside evaluation agency. Data reflecting student achievement has been validated by the Joint Dissemination Review Panel. Stones and Bones received the 1982 Certificate of Honorable Mention awarded by the California School Boards Association. Both California and the National Diffusion Network have identified the program as exemplary.

It would be interesting to conduct a longitudinal study determining the number of students who have changed to a more academic program as a result of participating in the Stones and Bones program.

## SUPPORT MECHANISMS

The school administration supports the program financially and gives consideration toward optimal scheduling of classes. Our administrators approved the inclusion of anthropology in the curriculum, met with appropriate department heads including science and social sciences, and presented various aspects of the program at community and staff meetings.

Parents and the community are extensively involved in the program. Participation through a continuing Community Project Advisory Committee provides an avenue of communication for the project, parents, and community. We meet periodically with The Community Project Advisory Committee to reevaluate the goals and needs of the community. We seek continuous input from the Community Project Advisory Committee as a gauge to determine community changes and needs.

## GETTING MORE TEACHERS INVOLVED

We encourage teachers to use the program through exposure to the program and its effectiveness. Teachers also visit demonstration school sites, and have one-on-one personal contact between experienced and non-experienced teachers. Involving teachers at the decision making levels where changes, new materials, and strategies are planned can encourage and stimulate the teachers to get involved with our program as well.

We schedule periodic in-service training workshops run by project staff and experienced, certified project teachers. We are developing a group of project certified teachers so that one is readily available when needed. Our project staff plans to conduct training workshops in various selected geographical areas outside Los Angeles to train and certify key personnel to serve as training teachers in their respective locality. State facilitator centers will serve as dissemination centers for the program and aid in the coordination of any requested in-services.

In beginning a new inservice, we arrange a first level awareness presentation to teachers, administrators, community people, and board members to introduce the overall program. We attempt to involve as many decision making people as possible. Then, we arrange a second level presentation for key personnel who will implement the program with "hands-on" activities to demonstrate and experience the innovative approach to the study of Physical Anthropology. A follow-up meeting with key personnel determines which pathways and instructional materials are needed. We also arrange for training workshops at adoption or project site. A one day training workshop is recommended for each pathway selected. We generally provide follow-up technical assistance during and after implementation. As in the case of all new programs, a close working relationship by those involved (administrators, teachers, community) is needed for successful program implementation.

The role of teacher education workshops is to familiarize teachers with the various components of the program and its implementation strategies. These workshops are led by recognized experts in the field of anthropology and/or by experienced certified classroom teachers. Also included during the workshop is the dissemination of information for background purposes and updating current trends/findings in the field of anthropology.

The role of teacher education workshops is the same as it has been in the past. As more teachers become experienced and the project certified, the role will be the same, but more locally conducted workshops are anticipated. Locally conducted workshops can add greatly to the further dissemination of the program.

Teachers need to possess basic skills in classroom management, particularly in reference to a laboratory activity setting. They must be "open-minded" because of the very nature of a program where problems may have multiple solutions. Enthusiasm and positive attitude by the teacher can be reflected in the students. No specially credentialed background in anthropology is needed, but teachers must have a working knowledge of the scientific method of solving problems.

## THE FUTURE

In the future, we expect basic program goals will remain the same, but changes in successive revisions of instructional materials and additional components for the classroom implementation will continue as new discoveries are made in physical anthropology. If we expand the program to other grade levels, we will develop appropriate instructional materials and make some changes in program goals.

We would like to have the program continue on the basis of its present extremely successful implementation. Some changes could occur as new anthropological field studies throughout the world are conducted. Information from these studies will be provided to the project via the L.S.B. Leakey Foundation, the project's cooperating agency.

We need periodic updating and revising of instructional materials and components to meet the needs of current students and to maintain relevancy for incoming students. Such program changes will result in continually having available the most up to date information for students and teachers.

We want to develop additional instructional components using computers. As more emphasis is being placed on computer technology, additional explorations in all three pathways using computers as the basis can enhance the effectiveness and relevancy of the program. We could also use computer programmed materials for remediation, review, evaluation, reference, and other programmable areas.

Scheduling a minimum of two meetings a year for all teachers using the program to discuss aspects of implementation and to plan changes through cooperative effort would result in an exchange of ideas and strategies that may be more effective and enhance the program.

To maximize the use of all available instructional materials, special consideration in scheduling of classes by the administrator is essential. Classes offering the program can be staggered throughout the day so that conflict in the use of instructional materials can be avoided. Such scheduling results in maximum use of available materials. In addition, we need assurance from the administration that funding will be available in subsequent years to add, update, and replace needed instructional materials.

Rewards for us have been many. We all appreciate the unique and innovative challenges associated with any new program. We also like the significant gains in student knowledge and concepts in the study of humankind. A significant decrease in absentee rate during the instructional periods due to the compelling nature of the program hasn't hurt our feelings either. We also see a "carry-over" effect from "Stones and Bones" to other disciplines through its interdisciplinary format.

Collectively, teachers involved in the program have been recognized for their contributions and dedication in a District published newsletter. Individual grant awards were received by several teachers throughout California from the State Department of Education for the implementation of the program.

**Project Leadership before, during, and after development has included:**

* Dr. Sid Sitkoff, Project Director
* Matt Matsumoto, Project Disseminator
* Many classroom teachers including Milton Anisman, George Bonorris, and Paul Lund from University High School - project's demonstration

**L.S.B. Leakey Foundation:**

* Mrs. Max K. Jamison, Trustee

**Los Angeles County Museum of Natural History:**

* Dr. Pete Lee, Former Director
* Dr. Craig Black, Present Director

**University of California, Berkeley:**

* Dr. Clark Howell, Professor
* Dr. Eric Meikle, Anthropologist and consultant to the project
* Other university staff anthropologists

**Independent Project Evaluator:**

* Dr. Laura Wiltz - Analyzed, interpreted, and validated statistical data

# Chapter 7: BIOLOGY I AND II

By

Bud Ellis

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Addison, itself a village of only 650 people, has about 1,300 K-12 students, down from a peak of 1,600 several years ago. We are a rural community with many residents commuting to other areas for work while our students must travel in to school. For the most part, it is a lower middle class to middle class community (the lake areas have most of the middle class).

The high school, built in 1960, has 450 students with 53 and one half full-time teachers. A new gym and middle school were added in 1978. The atmosphere in the school is friendly and cooperative, and our reputation has been one of excellence in education and in extra curricular activities. The six year old science center, known as the Biology room by the students, has a small window greenhouse (donated by the J.C.'s), an animal room, a special project room, and a large classroom with an office area. The school also owns a nine acre wooded lot near the school. Within walking distance of the school there is a series of shallow mill ponds which we use often.

## PROGRAM DEVELOPMENT

The school district does not have a mandated program. Each teacher has always been free to develop the program they feel is needed and will work. So, nine years ago, the program employed a textbook approach under a different teacher. We had no Science Center or animal room, no special project room, and little innovation. When I was hired, Mr. Don Dieck, the high school principal, told me the Biology program needed to be improved. He gave me the freedom and support to begin making changes. There was no pressure to implement an entirely new program immediately. Instead, I was allowed to experiment, to make mistakes, and to let the Biology program evolve.

The BSCS philosophy was a very important influence in my program development. The main idea obtained from BSCS involved getting students thinking for themselves. **The Science Teacher** and **The American Biology Teacher** provide much information for improvements in methodology. Another source of inspiration came from my personal philosophy of teaching. I believe in doing a job well, that being a good teacher is a full time job, and that the job of a teacher is an important one and deserves all that I can give it.

The first year, I got my feet wet as a teacher. I tried to do the best job possible for the students while at the same time learning what being a teacher was all about. The next three years were spent developing ideas and innovative programs and trying them out. Years five through seven were spent refining what was developed. Now, I am looking for new areas for creative program development and new methods to get the students actively involved in their education.

## THE PROGRAM

The Science Center is physically separated from the rest of the high school and includes a large classroom with tables, a small window greenhouse, an animal room with a variety of wild animals, a small office, a storage room, and a special project room. The classroom has gerbils in a habitrail suspended from the ceiling. On a table in the front of the room are the many plants, animals and other objects of nature continually being brought by students. Tables in the back of the room and in the greenhouse hold other plants and provide warmth for the entire room. We also have a stereo system which is used during labs and other appropriate times. The special project room for Biology II, the plants in the room, the animals and being a separate building all help create an atmosphere which is extremely conducive to learning. You can tell it's a biology room; it's a pleasant environment, and students have considerable ownership of both the room and its contents.

Biology I is a college prep class with a reputation among the student body of being difficult, but interesting. Students who take it strive for good grades and get them. There is usually a wide range of ability in the class. Biology II is a research project class that involves students working as research scientists on science problems where the answer is not known, not even by the teacher. Students have to come up with the methods and recognize the limits of their work. They work as individuals and as members of a small team, sometimes with a student director of research. Research is not used for Biology II alone. In Biology I, students do a research project every nine weeks. These projects are usually simple, but data must be presented in numerical form.

Eleventh and 12th grade students may take Biology II after Biology I. Although these students are those who can work independently, it does not attract all of the "good" students; particularly those who wish a more structured class where they know how they can get their "A."

In Biology I, I usually set the materials students use on the tables or at supply stations. In Biology II, students have access to the supply room. They are encouraged to spend a class period examining drawers and shelf contents so they become aware of the materials and equipment available. The students do a lot of improvising when it comes to equipment. In general, students do their own clean up work. However, we also have student aides to help with some cleaning activities. The standards in Biology II are high and students are expected to think and act as a scientist doing research.

## GOALS AND OBJECTIVES

Our broad goals are for students to:

* Learn and experience the basic inquiry and

investigation processes of science;

- Show the student that science is not remote and above the society that supports it;
- Learn basic facts, concepts and principles of Biology, and the field of science in general;
- Develop favorable attitudes toward Biology and Science
- Gain a knowledge of science as a career choice
- Develop an awareness of the environment and man's role in it.

Many of these goals are achieved through the study of science related social issues. We look at how science has affected society-- discussing test-tube babies, artificial insemination, genetic engineering, sperm banks, and how science advances are allowing people who would have died to live and reproduce. One of my goals is to take a creative approach which will allow, if not force, students to get really involved in the unit they are studying. They have to use the material (both facts and ideas) to figure out the problem or question.

In Biology II, we also have units on government and science, the law, religion and science, who pays for science, the history of science, and current scientific topics in the news. The focus of Biology I is more subtle than it is direct. While we do not study man directly (except in ecology), it is impossible not to bring out the human impact of science.

We want students to use their scientific knowledge to make decisions. The best examples in Biology I include the Road Problem, concerning the government paving a wilderness area road, and the Baby Experiment, involving a parent faced with the probability that their baby will be born with a genetic problem.

The Road Problem looks at the government's use of public land. This involves students in questioning how best to use natural areas for the benefit of man. The Baby Experiment looks at abortion, state institutions and home care for children born with genetic problems. Related new articles are brought in and their implications discussed.

The Biology II class also has written majority and minority position papers on government funding of embryo and test tube baby research and sent them to appropriate government committees. Other discussions have centered on the ethics of scientists working to build better war materials, drug companies looking for profit first, and social changes taking place because of new science or technology.

Each Biology I student does research on a problem during each nine week period. Other parts of the course are more traditional, but we do not follow the text. We study birds around Thanksgiving and insects in September. In this way, the student is more inclined to want to learn the material.

During the last two to three weeks of Biology I, the students explore, at their own pace and choice, different science related careers. Science related jobs are frequently mentioned and newspaper or magazine articles discussed throughout the course.

The impact of science on man and society is a central theme in Biology II with the entire Biology II course being problem centered. Students select and work on one research problem each nine weeks. The goal is to put the student in the position of a scientist doing research.

I try to make classroom activities as relevant as possible. Students are encouraged to bring in local plants, animals and other things found in nature. I always use local examples when possible and rely heavily on the local woods and mill ponds for study areas. Biology II students study the mill ponds in depth and make a public community presentation on their results. They also have worked with the local flower shop to try to find out why red carnations get brown spots so fast. Students working on the Road Problem issue used Michigan's high unemployment rate to make their case to build the road.

Individualized instruction is limited in Biology I. However, students do have the freedom to pick the careers they wish to study for the career education unit, the role they want to play in the Road Problem, their choice in the Baby Experiment and the problem they want to do for the nine week experiment.

In Biology II, students work at their own pace within a nine week time frame. They are free to pick their own research and in fact must do so in three out of four nine week periods. Many select their own research topic for the final nine week period as well. This course is quite individualized and personalized.

Biology I students often work in small cooperative groups. During the Road Problem, students are divided into two groups representing positive and negative aspects of the issue. Each team works to sway the forest service to do it their way. Students also work together during debates on the Baby Experiment issue and during regular laboratory sessions.

Cooperation is a key component of Biology II as well. Student groups of two or three spend the first nine weeks working on a problem. During the third nine week segment they work as a research team with a student director. During independent research, students are encouraged to help each other just like scientists would in a lab. This may include help with ideas, designing equipment, collecting data, finding supplies or writing their reports.

Biology I emphasizes local plants, animals, and their ecological interaction, DNA, and genetics. The Biology Baby Experiment, along with the local plants and animals brought into the room, are essential components of the course content. Biology II emphasizes planning and organization of research statistics, writing a scientific research paper, and the societal ramifications of science. But, I do not see how a science teacher would teach if they were not committed to human welfare and progress. Isn't this what science is all about in the first place?

The role of Biology I students in planning lessons, classroom management and decision making concerning course content is very limited. However, some of the lessons do have student evaluation at the end. For example, during the Road Problem simulation, a group of three students act as the U.S. Forest Service and make a decision after hearing student arguments. Student grades on the project are determined by this decision. There are many projects where the students grade each other following criteria provided. Examples of projects evaluated by students include the insect collection, the scavenger hunt, and models of DNA and the cell. Also, students are asked to provide evaluations of certain units including suggestions for improvement. This is done with the Road Problem and the Baby Experiment units.

Biology II students are very active in planning lessons, decision making and classroom management. Within the limits of the teaching situation, students are treated as if they were research scientists. They select their research problems, set their own pace, and decide what they will do at home or at school. About 60% of our students take Biology I and 10% take Biology II.

Student aides care for the animals and plants, and record grades in my grade book. This help frees me to do other things. In Biology I, I attempt to present the chapter material in a relevant sequence. For example, birds are studied during Thanksgiving time, pine trees at Christmas, and insects in September. DNA, genetics and other more difficult material comes during the winter when the students are most likely to want to study.

In Biology II, students work as a team of two or three the first nine weeks. Then, students work independently during the second and fourth nine week periods. During the third nine week segment, they form a research team and elect a director of research to lead them in some area of research.

During the DNA unit, there would be class discussion, DNA model building, lectures about how DNA is made and reproduces, and discussion about news articles relating to DNA. Students would use microscopes to locate the stages of mitosis in whitefish and onions. Students are allowed to be creative with the cell and DNA models, are very active in searching for possible solutions to the Road Problem and Baby Experiment, and seem to enjoy working with the wild animals and nature artifacts. The use of newspaper articles in the class helps to keep us current. In Biology II, the research topics are those selected by the students. As student interests change, so do the topics.

## EVALUATION

I do not test social and personal areas as I feel that there are no correct answers for the students to give. My primary goal is to have students interact with the issues. The students are still trying to figure out personal values, ethics and potential action. A tremendous lesson has been learned when students realize that both sides have valid points. Schools can only evaluate a fraction of what students learn. A survey of past Biology I and II students would be most helpful in evaluating the success of the program. Students are instructed to select the best answer, not the one correct answer.

During the Biology II research experience, students learn to conduct research, ask questions, and in general how to function as a research scientist. There is a significant improvement in the students thinking from the first nine week period to the last. For example, in the first nine weeks, most students have a very difficult time selecting a research topic. By the last nine week period narrowing their choice to only one topic becomes the primary challenge. They have learned to identify problems.

Addison students appear to do well in college, but credit must be given to the total school and not just the Biology program. In general, former students say they were well prepared for college biology. Many students who have taken Biology II felt they had a more thorough understanding of the processes involved in doing research and had a better understanding of descriptive statistics as well as the use of the T test in hypothesis testing than their fellow students. In Biology I, chapter tests, questions on worksheets and special projects like making cell models or DNA sequences are used as evaluative tools. Some units have student evaluations of other students as an integral part of the unit. The grading scale is A = 90%, B = 80%, C = 70%, D = 60%

In Biology II, I evaluate the written research report and student work habits during each lab session. Grading is done on a curve on the research report and depends each year on the quality of the work submitted.

Additional time is needed to revise current test questions, develop two sets of exams, and create new units. For example, I would like to add to the Road Problem by introducing a new issue--the River Problem. The AuSable River in Michigan was the focal point of a major dispute about the conflicts between different user groups. This issue could be developed into an excellent role play. In an effort to respond to student input, many of the teacher- made materials are revised each year. The Baby Experiment is very special for me. Students learn about being a parent and the difficult decisions some parents have to make about having a child with a birth defect. It gives me a feeling of personal satisfaction to know that I have helped to prepare them for life's difficult choices. Also, students leave the program with a better understanding of human issues and problem-solving approaches.

## SUPPORT AND ENCOURAGEMENT

I am pleased by the knowledge that when students leave the Biology program, they are well-prepared. If they do not take another Biology course, they are prepared to understand the basic biological principles that may affect them in the years to come.

As with all teachers, it is special when a student comes back or writes and tells you thanks, or comments on how useful information learned and skills developed as a result of your course have been to them over the years. Students are encouraged to discuss Biology at home. Some assignments involve students in discussions with their parents. In Biology II, occasionally parents have to provide funds for the student to conduct their research or space for the research if done at home. Parents also get involved by finding things for students to bring to class. Parents call wanting to know if I would like to have a snake or turtle that they found. Also, I am called upon to answer questions about animal types and the care of sick plants.

This support from parents is matched by the support from the administration. The principal allows us to teach in ways we believe will be effective with no set curriculum a teacher must follow. I was free to develop the Biology program according to what worked and within the framework of my teaching 'personality'. Administrators set the budget amount, teachers select how to spend it. Teachers determine the curriculum materials, evaluation of program, and evolution of the program. Teachers choose the inservice topics they wish to attend.

I also have been encouraged and inspired by the **Michigan Science Teacher** meetings and their many teacher-led sessions. The **NSTA** and **NABT** journals have helped with ideas, information, and have provided a sense of worth and value in my approach. Teachers need those contacts (both in person and in writing) to stay fresh, alive and caring about their job.

## THE FUTURE

But, while we have a good program, we aren't perfect yet. The advanced Biology II class should have its own project room. Having an animal room is better than keeping the animals in the classroom. At Addison, storage space in Biology is a problem and should be increased. The program is most effective when in the Science Center. There is a need for equipment (pH meter, new skelton, microscopes, etc.) and for computers (PET and Apple II+). More storage space and replacement of dilapidated microscopes are high priority needs.

I need to improve the number of student-lead activities such as the Baby Experiment and Road Problem. It would be good to increase the use of computers in the course, especially in the Biology II program. The use of computers in Biology I would allow us to study more complex issues and have students more actively involved. For example, population fluctuation programs would allow students to use what they have learned by inputing various changes, say as a forest manager, and discovering what effect these changes would have on the population. In Biology II, computers would take away non-productive time spent doing statistics and give students more time for actual research. It would also allow more detailed analysis and prepare the student for the actual world of the scientist. But, the continued lack of funds for schools in Michigan with the resulting budget cuts and teacher pink slips will take away from all programs at Addison. No one has a sure-fire solution to the problem of scarce funds for educational programs.

## TRANSPORTABILITY

Personal contact, encouragement and start-up assistance would be needed in order for other teachers to use this program. Also, Addison is a small school where teachers have three to five preparations per day. It is difficult to be creative and at the same time prepare what is needed when you have so many preparations. This is complicated by the fact that the preparations change from year to year. It would be difficult to package the Biology program like BSCS was packaged as much of our success comes from the teaching style and personality of the teacher. Some of the teacher-made items could be packaged and inservices held allowing teachers to take these packaged materials back to other schools. Some of these materials are complicated (so the student must think) and would have to be explained in detail in order to be effective.

One thing is clear, if teachers are to do a good job, the minimum necessary is an environment where good teaching is possible. To start in another school, it would be critical to get the 'right' teacher for the program. Special projects would need explanations. This would be critical for the teachers of the program and recommended for staff as well. Teachers need to listen to students, develop an active and creative mind, continually foster their own interest in science, and enjoy their teaching role.

This right teacher must love to teach; must enjoy giving students a challenge. He should understand how students can be challenged without feeling overwhelmed. He must understand the methods some students use to get the highest grade with the least 'mind work'. Teachers should love an intellectual challenge, have an excellent knowledge of the subject matter, be willing to work hard, and enjoy and understand young people. They should expect to learn along with their students.

Dr. Richard Pippen, Mr. Ray Deur and Dr. VanDevender, all of Western Michigan University, had a hand in shaping my teaching style. These individuals cared about their teaching and the students in their charge. They went beyond the textbooks and I could see they loved what they were doing.

I must also include Mr. Al Clark of the Kalamazoo School System. He was my supervisor for student teaching. He was the first to evaluate my strengths and weaknesses as a teacher. The suggestions for improvement I received from him were invaluable. At Addison, Ms. Evelyn Burns, was a source of inspiration and encouragement as the Biology program evolved.

# Chapter 8: DREY LAND ECOLOGY STUDY

By

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John Burroughs School, in the western St. Louis suburbs, is a private co-educational country day school attracting students from the entire metropolitan area including the city of St. Louis and the area across the river in Illinois. Even though tuition is $4,500 per year, close to 10 percent of our students have minority backgrounds. We are a college preparatory institution emphasizing academics, arts and athletics. Students are admitted to the school on a competitive basis with an entrance test and a personal interview as part of the admissions procedure. Approximately one third of all applicants are admitted. Student interests are primarily academic. They tend to be competitive while the institution is more caring, friendly and humanistic.

Students enter John Burroughs in the seventh grade. The sex distribution is even and there are approximately 90 students in each grade with a total enrollment of 550. Our students tend to be highly motivated and success oriented with high goals and aspirations. Student attitudes and values reflect conservative home life styles and the traditional American work ethic. These students generally come from upper middle class or even wealthy homes. But, ten percent are scholarship students from middle or lower middle class backgrounds and frequently represent various minority groups. The majority are academically able and could be classified as "gifted." IQ scores average 125 or better and past achievement before entering Burroughs is superior. I would say that the students attending our school receive a very demanding and testing education. They are continuously challenged to produce and to fulfill their potential. We have had as many as 22 National Merit Semi-Finalists during a single year, and a third or more of the class receive letters of commendation.

Class sizes vary from 12 to 20 with 17 being the average number of students. Generally classes are heterogeneous but a few accelerated sections are scheduled in mathematics and science. Advanced Placement sections in science are open to all students successfully completing chemistry.

Our 75 teachers include seven and one half full-time science teachers-- four biology majors, three chemistry majors and one physics major. All campus science classes meet in the Gaylord Science building constructed 16 years ago. It includes six laboratories, four classrooms, an auditorium, a greenhouse, an animal room, project rooms, an electronics room, a photography dark room, offices and a recently added computer laboratory. Our ecology study uses the Drey Land camp and outdoor laboratory, 150 miles southwest of St. Louis. Drey Land has a lodge, shower rooms, bathrooms, pavilion, and seven sleeping cabins.

Teachers at our school are expected to teach a comprehensive course in biology. Trustees, parents and students expect an academically challenging program of study which is also stimulating and interesting. There is some pressure to prepare the students for college achievement exams in the subject area. This limits content choice by the teacher somewhat, but certainly does not interfere with their creativity in devising a teaching strategy for various lessons, skills or concepts. Our ecology study was such a response.

## OUR BEGINNINGS

The Drey Land Ecology Study responded to the ecology crisis of the late 1960's. We tried an interdisciplinary year-long ecology course but it did not attract sufficient enrollment to reach the broad general school population. When the ecology elective failed, we decided to upgrade and reinforce the ecology unit in the first year Biology I course because we had 100 percent participation in that course. Furthermore, we saw the field study program, coming at the end of a year's work, as an ideal vehicle for reviewing concepts studied earlier and for pulling together and summarizing many biological principals. Now, field studies away from the school campus replace typical short term laboratory exercises in the ecology unit. These activities are good in an educational sense and the psychological atmosphere is totally different. Isolation in a primative environment drives home the point of man's relationship to the ecosystem with considerably more strength.

At the time the program was started, there appeared to be an acute need for the development of ecological awareness and for a basic attitudinal change toward resource utilization. We responded to the environmental concerns presented by media such as television, radio, books and magazine articles. Students also encouraged us through their awareness, interest and concern. Without positive feedback from our students at a very early stage in the program, stagnation may have set in! And, a land donation was a definate catalyst for the development of our program.

Mr. Leo Drey of St. Louis provided the land for the camp with the Dreyer Foundation providing some funds for camp construction. Edward Cessil, Headmaster of John Burroughs School, supplied leadership in the development of the physical facilities of the camp and inspired others in their work on program development. I, as Science Department Chairman, have directed the development of the Drey Land program and its implementation over the past ten years. Eric Hanson, the Camp Director, has taken excellent care of the physical facilities of the camp and cared for the students while they are at the camp. David Koenigs and Margaret Bahe have contributed much to the program through their dedication and creativity as biology teachers.

We began developing our curriculum at the same time we built the camp--1970-1971. We selected study areas, developed preliminary activities and prepared for a trial program. That trial, in the Spring of 1971, saw three groups of 25 students spending two weekend days at the camp. Based on that trial, we revised our materials and developed new activities suitable for a four-day program. Now, all Biology I students spend three school days and one weekend day at the camp.

We are continually revising our Drey Land Field Study Manual and Guide. For example, over the past ten years, the forestry portion of the Drey Land study has changed dramatically because of the various habitat improvement projects initiated. These continue to the present with groups of students going out weekends to build rabbit habitat and to survey the squirrel den boxes. We also have just started a barn owl habitat improvement project which should prove interesting over the next several years. We feel we have a real success.

The Drey Land Ecology program is an outdoor laboratory extending over four days and nights. The appropriate teaching strategy would be that of a "coach." The teacher is constantly showing students how to do certain activities, but avoids giving answers. During the days at camp, data and observations are constantly accumulating. During the evening, analysis is the dominant activity. Questioning becomes important. Relationships are drawn from the data and summaries are made.

Teachers from other departments also come to the camp as staff members. Principals help us recruit these teachers and arrange for their absence from classes they normally teach. Our school lunch department also furnishes a cook, prepares a menu and orders the camp food. Cooperation from them is an absolute necessity.

Teachers learn to use the program through participation. Fortunately, two of our three biology teachers have been with us for nearly the entire length of the study. Since the field experience comes at the end of a year long course, even a new teacher is familiar with the overall objectives after that length of time. New teachers also visit the camp as part of their inservice training or as participants in other programs using the wilderness facility. During the year most faculty members will have been at the camp one or more times. By spring, they are thoroughly familiar with the setting and instructional objectives.

To make our short four days more efficient we have developed portable field kits for water chemistry studies and forestry work. We now have an extensive collection of field manuals and references, and a large number of live traps, a drift fence, and collection equipment. Field equipment for the forest work is transported to the camp in trunks. We have kits for each activity and these are individually used by student teams. Students are assigned to teams and the teams are responsible for picking up the equipment and returning it to the trunk. Teams work with an individual teacher, so it is easy to keep a check on supplies and materials.

## OUR GOALS

The ecology study at Drey Land is primarily concerned with the development of positive environmental attitudes and ethics through the study of ecology in a wilderness setting. There are many possible ways of educating for the modification of attitudes and values. Our program is short, intensive and outside of the school itself. We remove students from the artificial crutches of civilization and immerse them in a unique and rather primitive environment at the Drey Land Camp. While there, everyone, including students, counselors and faculty, strives to live an ecologically sound life while at the same time acquiring a knowledge of the functioning of natural stream and forest ecosystems. Specific program objectives fit into three areas:

* Personal and social
* Subject matter knowledge including content and skills
* Values, attitudes and appreciations.

In the personal and social growth areas we stress the development of a spirit of friendship based on tasks requiring hard work, cooperation and a sense of humor. Because no passive amusements are permitted a further personal adjustment to the lifestyle of the camp is necessary. Finally, opportunity for the assessment and growth of one's own courage, self-confidence and trust in others occurs during the rappel, float, solo and overnight campout activities.

A lot of fundamental science is also taught at the camp. This fosters future behavior based on knowledge rather than pure emotion. It is our desire to start the building of ecologically literate citizens. Furthermore, each one of the stream and forest studies serves as an exceptional vehicle for reviewing and summarizing the work of the entire year. The camp experience seems to pull everything together. In the realm of scientific methodology, students experience techniques and acquire skills in:

* Sampling of populations and identification of organisms
* Measurement of abiotic conditions including soil and water chemistry;
* Use and construction of field equipment
* Use of diversity indexes
* Reporting, both oral and written.

Assigned field studies generate numerical data and specific observations necessary for the students to piece together a mental construction of the stream and forest ecosystems.

Their model should include:

* Recognition of microhabitats
* Knowledge of the abiotic environment
* Examples of succession, names of the principle inhabitants
* Recognition of trophic levels
* Possible food web for the system
* Related biogeochemical cycles
* Examples of the complementarity of organisms and their environment.

Positive attitudes, values and appreciations grow as part of the total camp experience. Faculty and counselor staff members set the example desired and the students are expected to follow suit. Respect for life is always observed and stressed. Organisms collected are, after study, returned to the stream or forest unharmed. Plant collections are held minimal by design. Caring for life is another objective. The value is observable at camp and has been acted upon via habitat improvement projects. Students have constructed and erected squirrel den boxes, wood duck boxes and blue bird houses in an effort to increase the population of these animals.

Respect for the environment is part of the life style of the camp as the camp itself is simple and in harmony with the surroundings. Energy use is minimal with waste treated in a sewage lagoon and never released. Water is obtained by well from a 500 foot deep aquifer. Non-biodegradable waste is hauled from the site to collection centers. Study areas are rotated to avoid damage through overuse. Our emphasis is on simplicity, conservation and adjustment to the environment. Everyone lives by the rule: "Do Not Disturb." Students also use the out-of-doors for all their recreation while at the camp. The float trip, rappel, overnight campout, cave work, and short hikes all convey the message that leisure activities need not be destructive of the environment.

Ecology is one of the most relevant studies and topics today; we see the program as being on target both locally and nationally. Many of our students, tomorrow's leaders and land owners, need an ecological conscience. To develop that conscience, the program involves a natural environment with activities at the camp as primitive and natural as we can make them for a group of 50 individuals at a time.

All of our objectives are at least partially attainable in the wilderness camp setting. By personally studying a small part of our unchanged world, the student develops an awareness that he is also part of the living world and is governed by the same natural laws as other life. Through this realization will come the growth necessary for becoming a responsible, caring citizen.

## A THEORETICAL FRAMEWORK

We want to give students the experience of living in harmony with nature while conducting a study of nature. To accomplish this, the student is transported to a primative wilderness and taken away from society's comforts and passive amusements. Naturalness is emphasized over artificiality. While at the camp, we try to take care of the environment as we study it. Collections are not permitted and all living things are returned unharmed after study. Life is considered beneficial and important even in spiders, insects and snakes.

The camp's primitive nature makes adaptations necessary. Students are removed from passive amusements such as television and stereos. Entertainment comes from companionship and socializing. Junk foods are left at home. On the overnight camp-out students sleep outside under tarps. They survive and discover much of our civilization's comforts are somewhat unnecessary. Furthermore, they are exposed to a more relaxed Ozark life-style on the trip to and from camp.

Students at the camp observe first hand a relatively surprising idea, the non-use of land; the concept of the preservation of natural ecosystems. Throughout their entire lives, students have been exposed to land development, new subdivisions, shopping centers and industries. At camp, it is different. Many even come away with the idea that it would be good to save a few undeveloped corners of the world. Since the camp is located on the edge of the National Ozark Scenic Riverway, students also see the use of land for recreation and preservation purposes. The stream and forest studies conducted at camp are based on inquiry with data collected by valid research methods. Students are expected to study the data, make appropriate comparisons and then draw conclusions. In general, the studies are self-contained and reflect the true scientific process. It is hard to look up answers in a texbook while at camp. Students attempt to collect scientifically valid information about two natural ecosystems. They sample the biotic and abiotic environment for the purpose of discovering relationships between the two areas as well as within the individual ecosystem. From the data collected, students are generally able to interpret community structure, food chains, prey-predator relationships and many other interactions.

Humans conduct the study in our program. For it to work all need to participate cooperatively and to share the burdens. Enthusiasm, happiness and joy become necessary ingredients for success. Students discover the value of team work, sharing and trust. Friendships are made and grow during camp activities. These are characteristics we hope to find in all humans. Teams complete all of the studies at Drey Land. Cooperation is essential and the establishment of this attitude is our most important task as teachers. Only reports are done individually and these are often discussed together by the team before actual writing begins. Visitors are always impressed by the amount of teamwork and cooperation they observe.

Team work is important, so the teacher must be able to establish goals for the group, find leaders, establish purposeful behavior and strong cooperative behavior. Students must feel they are doing something important.

A camp visitor would see the usual pattern of classes and laboratory studies. Over the four day period, I would expect an observer to see students talking, listening, reading, writing, measuring, observing, calculating, reporting, questioning, programming, thinking, reflecting, and working.

## OUR PROGRAM

Teachers are responsible for their own classes. When two or more teachers share a common assignment, they plan together, follow a common syllabus, share laboratory preparations and test construction. They also share the responsibility for selecting course materials such as texts and films and writing couse objectives. Teachers with multiple sections of the same course may work alone, but are still expected to prepare course objectives, a syllabus or schedule of activities, and to select appropriate course materials. All teachers work closely with the department chairman.

Most curriculum materials are developed during the summer vacation periods. Teachers are paid a small sum for the work and frequently share results. Academic departments are responsible for their curriculum and report directly to the Headmaster through department chairmen.

Teachers:

- Organize teams for specific camp studies such as water chemistry and aquatic fauna;
- Demonstrate techniques to be used in the field
- Conduct investigations with the study groups or teams
- Help with organization of data collected
- Question students relative to their techniques and the reliability of the data collected;
- Repair and organize equipment used by students
- Aid the students with their interpretation of data
- Build camp spirit, enthusiasm, morale, give encoragement and stress the job to be done;

- Evaluate student performance and achievement
- Act as a role model, caring, sharing, helping, promoting ecology and ethics.

Teachers avoid:

- Promoting competition between students
- Giving answers to the scientific problems being investigated
- Displaying cynical behavior
- Being unusually critical
- Contributing to the destruction of the camp's natural environment.

We generally feel that any good teaching strategy, if used exclusively, will fail due to sheer boredom. Hence, we use a variety of instructional methods selecting those that will enable us to achieve the desired goal. Sometimes this means reading from textbooks, listening to lectures, watching films, working in the laboratory or traveling to a natural ecosystem for first hand studies.

During the year, a regular biology textbook and laboratory manual are used. The book is the 1978 edition of **Biology** by Wienberg. Our laboratory manual has been developed by the science staff and is printed at the school. During the Drey Land study, we use a second field manual which is also developed and published at the school. This manual contains instructions for conducting the various field investigations and associated data tables. Summary questions and report forms are also included in this field study manual.

Students also use an extensive collection of books from our library during the year and have available many of the E.M.I. Programmed Learning Modules such as Meiosis & Mitoses, Cell Energitics, Cell Structure, Evolution and DNA.

During the year, we use films rented from the University of Illinois. Many single concept film loops have been purchased or produced locally. A number of these were made at our school illustrating our own apparatus. The school also has an extensive collection of 35 mm slides that have been purchased or shot locally. All visuals are used for illustrating concepts and many are used for testing purposes as a quick substitute for lab practicals. Computers are available and used during the Genetics, Evolution and Ecology units.

Since the Drey Land Ecology Program was developed specifically for the school's first-year biology students classes are drawn from both the 9th and 10th grades and are mixed by both sex and grade level. Ninth graders enter the program by selection and are in an accelerated science track. Students not selected for biology in the 9th grade take the course in the 10th grade.

Approximately 95 students are enrolled in the course each year. The group is then divided into five class sections of 18 to 20 students. All students are automatically included in the four day camp ecology study. Only students on academic or disciplinary probation are excused. Average attendance at the camp is at least 90 students per year.

Support personnel at the camp include a cook, 6 to 7 John Burroughs School teachers, and 6 to 8 John Burroughs School seniors. These people all share the same wilderness experience and special camp ethos.

The dates for the program are scheduled a year ahead of time on the master school calendar. For the past several years, we have been locked into either the second or third week of May. Two individuals have the most responsibility for organizing camp details. One, the program coordinator, recruits and trains staff, orders transportation, schedules the students, plans the program and sees that all special science equipment and supplies are on hand. This person's duties are heaviest before the camp. The camp director is responsible for the successful completion of the program as scheduled and for the care and feeding of the campers. Discipline, safety, and student morale are also concerns of this individual.

Three biology teachers and their counselor assistants instruct all of the scheduled classes. These teachers also contribute to the formal running of the camp when necessary and as time permits. Two non-science teachers are also part of the camp staff. They are drawn from other departments of the school and volunteer their help because of an interest in ecology. They assist the camp director, supervise the float trip, transport students, assist at the rappel site, help in the kitchen and generally keep an "eye" on things.

The counselors assist the teachers and supervise the sleeping cabins. They are graduating seniors or recent graduates of John Burroughs School. Most of the counselors are knowledgeable of both science and the out-of-doors. They found the experience both meaningful and enjoyable as campers and now are returning to make their contribution to the program.

From time to time, visitors also join the camp staff. These have included school administrators, science teachers from other schools and practice teachers from colleges in the St. Louis area.

Camp facilities are adequate, but not too civilized. A main lodge (24 feet by 40 feet) houses the kitchen and dining room. Between meals and in the evening it serves as an indoor classroom and laboratory. Toilets and cold showers are located in a second building. Nine primitive cabins are set back in the forest surrounding the lodge. Only the lodge and washrooms have electricity and running water. The camp does not have a telephone.

Forty-five to forty-eight students are taken to the camp at a time. The first group leaves for camp on Sunday morning and returns Wednesday afternoon. The second group leaves Wednesday morning and returns to St. Louis late Saturday afternoon. This schedule causes each student to miss three days of regular school and one day of the weekend. Students not at camp attend school as regularly scheduled. They do not, however, attend biology classes on these days.

At camp, the students are divided into three groupings (A,B,C) for class purposes. They are also divided into different cabin groups and assigned to one of the counselors. Class groups are organized to achieve a mix of abilities and skills. Cabin groupings allow for friendships and compatibility. Class groups follow the master camp schedule. The scheduled classes bring the student into direct contact with two study areas, the forest and the stream. Each student also spends two evening hours analyzing the data collected during the day. Activities planned for each study site can be found in the forest and stream manual. These investigations have all been used for several years and have gone through many revisions and subsequent improvements.

Because of the number of investigations conducted at each study site, it is impossible for every student to do everything. In order to broaden the experience of each individual as much as possible, they are cycled through the acticities on a daily basis. For example, while at the forest site, if they collect abiotic data on the first day they will be assigned to animal collections the second day and plant analysis the third day. A similar procedure is used at the stream. In the evening the information collected by individual teams is pooled and shared between all members of the group.

Specific sites for special studies have also been developed at the camp. The first of these is a drift fence that surrounds the sewage lagoon. This device captures animals entering or leaving the lagoon in pit falls along the fence. Frogs, toads, salamanders and lizards are frequently captured. An area 100 meters square has been staked out on the south slope of a hill. Steel reinforcing rods identify the corner of each 10 square meter quadrat. These quadrats are used for obtaining random plant sample and for the location of snake boards. One snake board, a one square meter plywood sheet, is found at the corner of each quadrat. These sheets provide cover for rodents and on occasion attract snakes. Live traps are also set out at the snake board locations.

Twenty-five squirrel den boxes have been positioned high in the oak trees throughout the camp property. These are checked for nesting or occupancy as part of the forest study. Flying squirrels and grey squirrels inhabit a high percentage of these boxes. Two years ago, 12 blue bird houses were set out along fence lines bordering open fields. So far these have gone unoccupied even though the species has been observed in the area. At the same time, several wood duck boxes were placed along the creek. These prospective homes have also remained vacant. This year we plan to do some clearing of the subcanopy in one area of the forest and pile up this brush for the improvement of the rabbit habitat.

DREY LAND SCHEDULE

| TIME | DAY 1 | | | DAY 2 | | | DAY 3 | | | DAY 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | A | B | C | A | B | C | A | B | C |
| 8:15<br>10:15 | LEAVE JBS | | | RAPPEL | STREAM | STREAM | FIELD | STREAM | RAPPEL | STREAM | FIELD | FIELD |
| 10:30<br>12:15 | ORIENTATION | | | | FIELD | FIELD | STREAM | FIELD | | FIELD | STREAM | STREAM |
| 1:30<br>3:30 | FIELD | STREAM | STREAM | STREAM | FIELD | FIELD | FIELD | RAPPEL | STREAM | LEAVE DREY LAND<br>ARRIVE JBS | | |
| 3:45<br>5:45 | STREAM | FLOAT | FIELD | FIELD | STREAM | FLOAT | FLOAT | | FIELD | | | |
| 7:15<br>8:30 | FIELD | CAMP OUT | STREAM | FIELD | STREAM | CAMP OUT | CAMP OUT | STREAM | FIELD | | | |
| 10:00 | STREAM | | FIELD | STREAM | FIELD | | | FIELD | STREAM | | | |

# EVALUATION

Testing is done both during and after camp. For accountability, students are responsible for all of the data collected. They also respond to a series of forest study questions and write a two or three page stream report. This must all be completed before the student leaves the camp on the bus for home. After returning to school the student is tested over the entire ecology unit of which the camp experience is a significant part. Student evaluation is based on their interpretation of the scientific data collected during the study.

During the Ecology study, students are evaluated subjectively for their **effort, cooperation** and **attitude.** The acquisition of knowledge and skills is determined by observation and test. On the last day of each camp session, counselors and teachers sit down together and rate each camper on the three criteria. Skills are observed and recorded by the individual biology teachers.

Student reports and questions from the field manual are completed and turned in before the student leaves camp. These are subsequently read and graded by the teaching staff. Finally, after all the evidence is in, students are assigned a grade for their work.

Evaluation of a program as described is difficult. We have tried with some limited success to obtain feedback from all possible sources and in several different ways. First, the program has been studied by three science teachers from two outside schools. In 1976, two teachers from Pembroke Country Day School in Kansas City were invited to attend the camp as outside observers and participants. They were asked to specifically study the tone or psychological atmosphere of the camp and to suggest improvements where necessary. In 1979, a St. Louis Country Day biology teacher attended the camp and evaluated the quality, quantity and methodology of the field studies. He offered several suggestions for improvements and these were incorporated into the revised field manual.

Another measure of the success of the program is that it is now entering its eleventh year. Soon, nearly a thousand students will have received benefits from the experience. These students also fill out evaluation questionnaires as they complete their year's study of biology. Questionnaire results rate the Drey Land experience as the most interesting and most beneficial of all work in biology.

There has also been a noticeable increase in the science enrollment for all courses since the inception of the Drey Land program. In 1972, 525 students attended the school and 450 students elected to study science. In 1982, 545 students attend the school and 525 students elect to study science. Considering that all courses beyond the ninth grade are elective, we consider the enrollment figures to be highly indicative of success. Enrollment in Advanced Placement Biology (a second year course) has climbed during the same time from 12 students to 29 this year and to 30 for next year. Students in this course also use the camp and are familiar with the program there.

A further sign of success is the number of students who volunteer to return to the program as counselors at the end of their senior year. Considering the demands on the time of the students during the spring term it is rather surprising that so many ask to work there and to donate their efforts. Past graduates also return to the program is the end of their college term occurs before the dates of our camp. It is always the exception if we do not have at least one returning graduate along as a counselor.

Testing is a part of the evaluation process, but because the program activities are intimately connected to the entire year's work, the Drey Land contribution is impossible to pin point. Standardized test results covering all course work give the following average results:

| | |
|---|---|
| * Nelson Biology Form E | 85th% |
| * Biology C>E>E>B> Test | 621 Average |
| * New York State Biology Exam | 75 Raw Score |
| * Advanced Placement Biology Exams | 3.7 Average |

Our present teachers think highly of the program. But, people do not run down their own creations. This fact makes it imperative that all of the teachers involved have a chance to revise and upgrade the activities each year and to see some change related to their input. Public and personal recognition is also important. This will continue to be given to those contributing to the camp program. Teacher attitudes have changed as well. The greatest change in teacher attitude seems to be in our awareness that it is possible to teach to achieve a modification of values and attitudes. These affective goals are now considered important and attainable.

We would like to be able to administer a pre and post- camp environmental attitude and awareness scale. So far we have not been able to acquire such an instrument from another source. If such an evaluation device exists, we would like to test it out in our situation.

Students evaluate the program each year via a questionnaire. We also hold a post-camp staff meeting for the purpose of disucssing program accomplishments, necessary changes and minor trouble spots. When possible, we involve outside people in the program as counselors and teachers. They bring fresh ideas to us and have the ability to see the program from other vantage points. Several improvements have been made because of these evaluation activities. We rely most heavily on those student evaluation questionnaires and on the personal reports and responses from participating adults.

Our school conducts a formal survey of our past students two years after their graduation from high school. The questionnaire used in the survey is primarily related to their academic and social readiness for college. There is a possibility that the Drey Land experience could be evaluated as part of this survey. The questionnaire would be given four or five years after their camp attendance so any residual effect might easily be detected through appropriate questions.

Our wilderness camp has added to our offerings at home, as well. We now have a rich data bank of the area acquired over the past ten years with the possiblity of extending the data collection well into the future. We use these data, memories, and possibilities frequently in our classrooms. Logistics is a major problem. We constructed "trunks" for safely transporting microscopes and field study kits. We bring 26 binocular microscopes with us to camp as well as water chemistry kits such as oxygen, nitrogen, and pH. Our stream nets, collecting nets and seines are stored at the camp.

## THE ADMINISTRATIVE PROCESS

Our principals work more with students than teachers. Each principal is responsible for two grade levels. They advise students with registration, supervise grading etc. They also contribute to the evaluation process for teachers. Departmental organization is strong at Burroughs, and other than the Headmaster, this group has the most influence on teachers.

Program decision making responsibilities are delegated by the Headmaster to the Department Chairman. Inservice training that cuts across departmental lines is provided through programs developed by the Headmaster. Programs for science teachers are developed by department members. Budgets are prepared by individual departments and submitted to the Headmaster. Budget size is generally based on demonstrated need. The budget is submitted by January 1 and approved without significant changes. Curriculum materials are requested by individual teachers or teacher teams and approved by the department chair. Teacher inservice is most generally a summer activity. Teachers individually or as teams request summer funding support. This could be for tuition or salary for curriculum development. Requests are approved first by the Chairman and finally by the headmaster. Department Evaluation is conducted according to the plan attached. A school wide accreditation evaluation is also conducted every seven years. Planning is a departmental responsibility under the leadership of the department chair. Planning requests may come from the headmaster or arise internally within the dept. Program evolution has for the past 18 years grown out of the science department itself. Changes have been gradual but continuous.

The Drey Land program costs each student $40. Significant expenses are for transportation and food. The cost of science supplies and equipment used in the Ecology study comes from our regular department budget.

Our total science department budget for the year 1982-1983 was $17,200. These funds will be used for the following:

| | |
|---|---:|
| capital items | 3,000 |
| supplies and films | 8,500 |
| copy expense | 600 |
| dues | 100 |
| field trips and travel | 1,500 |
| equipment repair | 1,500 |
| student lab assistant | 2,000 |
| | $17,200 |

This is approximately $31.00 per student each year.

## SUPPORT

Our administration has been supportive in the following ways:

- Provisions of funding for the camp
- Providing time in the academic calendar
- Encouraging participation by faculty members from other departments;
- Providing reinforcement for the work of science department.

Professional organizations are important and our memberships in them are invaluable. Independent school teachers tend to become isolated from public school teachers because our problems are viewed as different. Professional organizations provide a common focus on issues, problems and new developments. They are a stimulus to keep teachers moving forward. We would be lost without these excellent professional organizations for science teachers.

Professional journals are a help to us in several ways. First, the book reviews, film reviews and the reviews of other media keep us informed as to what is new and an idea as to how good it is. The advertisements are also helpful in this area. Articles, particularly those involving new programs, studies and techniques, give us ideas or confirm the appropriateness of our techniques. Articles involving advances in science are not particularly useful because information from other sources such as **Scientific American, Science** or **Science 84** is so much better.

## THE FUTURE

Our Drey Land field manual needs revision in order to improve the way we collect our data. Several of the tables and charts are also diffucult to interpret. It would also be helpful to be able to take Biology I students to the area for pre-camp activities throughout the year. This could involve small numbers of students on weekend outings only. Students could carry out additional habitat improvement projects as well as work on camp upkeep and repair projects. Some students could also begin small individual research projects if more frequent trips to the area could be taken.

We need additional pre-camp laboratory activities that teach specific field measurement techniques. We find ourselves using valuable camp time either explaining how the study is to be accomplished or instructing the student in special techniques. More camp preparation is a definite necessity. A small revision of the Biology I Ecology unit could accomplish this need and would only involve three teachers.

We need to develop an additional study area in a region of the forest designated as the lower slope. This would include stakes from 10m2 quadrats, snake boards, a drift fence, and live traps. Ideally, we should lay out an area 100m2 into 10m2 quadrats.

Under our lease arrangement with Mr. Leo Drey, the camp is open to outside groups if they have a program promoting nature study or ecology. We should probably initiate some cooperative activities with other schools to inform them of our work at the camp. If interest is shown after a trial experience, they could use our facilities and program.

I would like to see the program grow and extend over the entire year by taking small groups of students to the camp on weekends. This would also be an ideal time to involve groups of students and teachers from other schools. Further back in my mind, but also possible, would be the involvement of practice teachers from one or more of our local universities. It would seem that an outdoor laboratory would be a nearly ideal teaching situation for an individual considering education as a career.

Consequences of implementing the above program changes would include:

- Additional teacher and student involvement and commitment

* Increased transportation costs
* Reduced "coverage" of biology in the first year program
* Greater understanding of ecology and a greater appreciation of natural ecosystems by students.

## CONCLUDING COMMENTS

To establish the program in another school, I would start with a teacher who wanted change and who wouldn't be afraid to work to attain an ideal. "Clock watchers" need not apply because most improvements are 99 percent prespiration and one percent inspiration. However, teachers should be aware that the personal satisfaction they will receive will far exceed their own time committment. Teachers will need a lot of support and help from colleagues, coordinators and administrators. Objectives and goals need to be established and students should become involved at this stage. In fact, student enthusiasm and excitement could be the most important ingredient. They have both the numbers and the energy needed to drive a program forward.

Teachers need a knowledge of natural history and ecology. They also need knowledge of how field studies are designed and conducted. A personal commitment to conservation and preservation is also important. The teacher's value system is exposed so it is easy for a student tc detect inconsistencies in their thoughts and actions.

New teachers would obviously need to be good biologists and to show the traits of a biologist in their work. They need to feel compelled to change our attitudes toward the preservation of our planet's ecosystems. If they are not committed or feel that change is impossible, they would not be effective.

The main reward for teaching in the program is personal satisfaction. Seeing students grow in awareness, appreciation and concern for environmental improvement is the most satisfying of rewards.

Different teachers in the program have presented papers to conventions of science teachers. One paper was given to the National Association of Biology Teachers and another to the Independent Schools Association of the Central States.

I think that we have also seen that everything of an educational nature does not have to happen within the four walls of a classroom or laboratory. We seem to have become much more open to the use of outside resources and local facilities. We are less "teacher centered" and more "learner centered." Without support from the entire school the program would have been an early failure because both substantial resources and time are involved. Taking students away from school for the major part of a week involves sacrifices from all academic departments. In addition, when teachers are gone others have to pick up an additional substitute burden. Classroom teachers do not like absences because they have their own objectives to accomplish. We are fortunate that the science program is accepted and supported by all faculty.

The four day total immersion in field studies at the camp is unique. The camp experience is so intense and all consuming its educational effect appears to be magnified. Perhaps we should develop the concept of an intense experience for other efforts to modify values and attitudes. A kind of "shock treatment" may bring about changes more rapidly than dispersed or continuous instruction.

# Chapter 9: ECOLOGY AND THE COMMUNITY

By

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Jamestown, population 4,000, is the only town on Conanicut Island in Narrangansett Bay. This small island is considered to be part of Rhode Island's suburban/rural South County and is linked by bridges to the mainland. The community school, attended by a variety of socio-economic groups, has been eligible for Title I funding since the beginning of that program. Five hundred students attend Jamestown School in grades K through eight. The single building school, built in 1955, was renovated in the early seventies to create open classrooms in grades one through six.

Although resources are modest, there is a high sense of esprit de corps and cooperation throughout. The thirty-two teachers plan most curricula and participate with the Administration and School Committee in hiring new members. Significantly, Jamestown School is consistently at the top of the state in standardized testing, competitive grants, and awards.

Today, as resources are declining, taxpayers are asked to vote funds for various environmental protection projects and to support positions for or against policies which affect the world in which they live. Without a basic understanding of life science, voter opinion is often swayed by the biased positions of various pressure groups. No meaningful long-term management of the conflict between the environment and society can be realized in such an uninformed climate.

Strong science education with an orientation toward application can provide the necessary background from which to make judicious choices; choices based on carefully considered priorities, not short-lived headlines.

Ecology and the Community provides this necessary background. It's goals are long-term and practical. Environmental programs which tend to give the student an idealized, one-sided picture are hard to reconcile with economic reality. The resultant attitude that environmental concern is impractical can be more damaging than no environmental program at all! This project, therefore, does not pit environmentalist against industrialist, rather it encourages both to cooperate toward the long-term good of the environment and the community. To prepare future voters, we want students to understand their roles and responsibilities as determiners of alternative futures.

## ECOLOGY AND THE COMMUNITY

Ecology and the Community begins in the fall of the seventh grade year when students study different forms of life, learn about requirements for survival, and explore responses to long- term change. Topics covered include:

- * The cell, its principle parts and their function--
  One-celled life as introduction to life in general;
- * Photosynthesis and respiration, energy systems of the cell
- * Food chains, food webs, and feeding relationships
- * Decay organisms and their role in feeding relationships
- * Population limiting factors in the environment
- * Basic genetics as a mechanism for continuation
- * Selection and adaptation and long-term change.

With this background, students undertake an extensive investigation of an outdoor site in the spring of the year. The core of this section of the program is the site study kit; a complete lesson and investigation which can be used by students without teacher assistance. Working in groups of four, students choose those kits which they determine will provide necessary information about their site. We have twelve such kits:

Aquatic Biology
Botany
Zoology
Soil Biology
Soil Fertility
Soil Water

Soil Particle Size (mechanical analysis)
Water Minerals
Dissolved Oxygen
Foam (Tannin and Lignin)
Detergent
Just For Fun (Artistic and sensory perceptions)

Based on all the information they gather, students prepare a site summary; a statement of the present condition of the study site and a prediction of the future changes which they expect will occur.

## GOING INTO THE FIELD

In the spring of the year, usually after May first, seventh graders in this program investigate South Reservoir. This investigation provides direct experience with concepts presented earlier in the year.

South Reservoir is a four acre man-made water impoundment surrounded by ten acres of marshy woodland. The contiguous buffer zone consists of low density farmland. This site provides students with an opportunity to explore a relatively undisturbed and varied habitat.

Fieldwork begins with an orientation which allows students to see the relationship between the preceding classwork and their outdoor investigations. General "housekeeping" points are covered and the kits are introduced. This orientation ends with the establishment of four-member student teams. Except in unusual cases, teams are selected by students.

Student teams then pick their first kits. This is the only time when all teams within a class select kits simultaneously. Conflicts are resolved by lot. As soon as kits have been selected, the teams begin the check-in procedure. Kit contents are inventoried and the team logs in as the present user of their kit. The team then begins the study assignment which explains the purpose and methods of the kit. Teams qualify with their kits by passing a ten question quiz with a minimum 80 percent score. High productivity is important to us, and checkpoints such as the qualification quiz help to insure that students will fulfill their responsibilities even when working with minimal direction.

After orientation, the remaining weeks of the school year are organized into classwork days, "in days," fieldwork days, and "down days." Although this varies from year to year, Monday, Wednesday, and Friday are usually "down days" while Tuesday and Thursday are usually "in days."

Management of a fieldwork day is a carefully choreographed event. Our class periods are forty three minutes long, so there is no place for wasted time. A "down day" begins as the teams file into the classroom and collect their kits from storage. After logging in for the day and completing the kit inventory, they board the waiting bus to go "down" to the reservoir. Each kit has a long-ring kitchen timer attached to its front and at the end of the five minute run to the reservoir, the teacher directs the students to set them for the time available for fieldwork, typically twenty to twenty-five minutes. At this point, the students are largely on their own. During this time, all field decisions are made by the team members. They choose the location, the kit activities, and the depth of each of their investigations. As the timers begin to ring, the teams head for the bus which leaves five minutes later. During the return trip, the kits are again inventoried, damp sponges are passed out, and the kits are cleaned. On arrival, the kits are returned to their shelves and the students go to their next class. All in forty three minutes.

The next day, an "in day," the teams perform any laboratory work necessary and catch up on their notebooks. Careful record keeping and the ability to express observations and conclusions in word and letter are also important to us. On these days, a team may elect to log out of their kit and choose another from those not in use.

After years of field study teaching experience, I feel strongly that true freedom of choice as practiced by young adults begins with a supporting structure. If the structure is inadequate, the quality of self-directed learning becomes moot. I feel that we have struck a productive balance point with this fieldwork procedure.

## SOCIAL STUDIES

Of equal importance is the concurrent study of the community. In order to provide the balance necessary to avoid a prejudicial, pro-environment point of view, these students learn the hard realities of community costs and limited financial resources. Social Studies topics include:

* Basic economics

* Recent local history and community background

* Town government

* Town services and their costs

- Town industries and businesses
- Taxes
- Town budget
- Jobs and the job market.

These topics are addressed through a series of activities, simulations, interviews, personal research, and guest speakers. By drawing parallels between their own community and the environment, students come to realize that the impact on a herd of deer of a 10 percent decrease in food supply is similar to the impact on a town of a 10 percent loss of jobs.

## DYNAMIC DECISION MAKING PROCESS

The culmination of Ecology and the Community each year is a series of simulations in which students must make difficult choices between environmental and community concerns. Before the entire student body, the seventh graders present both sides of an environmental question and hold a school-wide referendum. At this point, students realize that although any given issue may be decided for or against the environment, there is rarely a wrong position, but rather, different points of view.

## CROSS-AGE TEACHING

In September of the following year, these students, now eighth graders, begin a cross-age teaching component of Ecology and the Community. Teams composed of two student volunteers, typically will present a lesson to a small group of students from grades K through 6. Lessons are planned by the sending teacher, the receiving teacher, and the team itself. Teachers adopt a supporting role and allow the team as much latitude as possible. Through this cross-age teaching opportunity, student knowledge is reinforced, the science experience of the younger students is broadened, and the over-all impact of Ecology and the Community is enhanced.

## DISCUSSION

In the Criteria for Excellence in Biology, an excellent biology program:

> "...focuses on helping students use biological knowledge to enhance the understanding of themselves and to benefit the quality of life and living for human beings. The study of the human organism in its natural, cultural, and psycho-social environments is essential---this includes a focus on human adaptation and future perspectives for human welfare."

Except that the design of Ecology and the Community was largely completed in 1974, one might think that this program was designed to match the NSTA criteria. In our planning, we asked ourselves, as did NSTA, "What is needed for the over-all good?" We feel that the similarities between our program and the biology criteria confirm the validity of our effort.

Ecology and the Community is the result of a very frank science curriculum analysis. The question "What shall be taught?" very quickly led to "Why teach science?" None of our answers were especially compelling. Most involved assumptions which were predicated on other equally vague answers to the same questions.

Formerly isolated from Rhode Island by a toll bridge and ferry, Jamestown had been spared the population pressure and attendant environmental decline common to more metropolitan communities. This idyllic existence was being challenged by the general movement of population to the more rural areas of Rhode Island. With the closing of the Naval installations at near-by Quonset and Newport, Jamestown's economy was declining. Under these circumstances, the temptation to make short-sighted decisions affecting the use of the island's resources was strong. Jamestown would be served best by an informal electorate able to weigh both sides of resource-use questions and choose that course which promotes the long-term good. Thus, the needs of the community became the guideline for developing, and the benchmark for evaluating Ecology and the Community. This guideline answered our original questions and provided philosophical insight while developing the program.

The strengths of Ecology and the Community are its long term goals and organization. Although different issues have come and gone, the need to make wise decisions remains. Many of the original circumstances which existed in 1974 have changed. The local economy has recovered from the closing of the two near-by Naval installations, but the island population has increased by 25%. Because the pressure on finite environmental and financial resources continues, our long-term goals remain valid and durable. The project organization is by objective so that what is taught remains constant. How the information is taught is flexible making substitution of new methods easy. There are no preconceptions regarding school organization, class organization, teaching philosophies, teaching techniques, or other "how to" considerations. Teachers of different temperament and style can participate with equal success.

Ecology and the Community can be transported easily to other schools. This program is organized by objectives so that equivalent materials or programs already in use in an adopting school can be substituted. With no preconceptions regarding methodology, no major changes in school or teacher philosophy are required. The cost of adoption is low because the amount of new materials to be purchased is small.

## EVALUATION

Ecology and the Community has been evaluated in three areas: pre-post testing, on-site visitation, and follow-up questionnaire. In spite of three revisions, we have been unable to demonstrate conclusive results through formal pre-post testing. These efforts have looked for changes in the way seventh graders make decisions and are primarily in the affective domain. The data range from very significant to not significant at all. But state evaluators, visitors from other schools, and other visitors to Ecology and the Community have been consistently enthusiastic about our program. Specific points which are frequently cited include:

* Implementation can take place in another school without schedule changes or radical changes in school philosophy;

* Flexible activities within a framework insures the accomplishment of objectives;

* Students are actively involved

* Simple, inexpensive, but high quality equipment is used

* Organization is casual, but highly efficient

* Social issues are truly united with science to produce a hybrid program;

* Cross-age teaching teams maximize the impact of financial support.

One theory regarding our inability to show significant change through pre-post testing holds that seventh graders may have internalized the informed decision making process, but are not yet able to express it. To explore this possibility, we have begun to mail questionnaires out to high school graduates. These students completed our program in 1978.

Although there are too few returns (17) at this time to warrant a full analysis, the trend is abundantly clear. Our theory was correct. We had set out to help tomorrow's citizens make wise decisions. Five years later, we are finding our efforts were successful.

## Sample Subsection of An Environmental Situation Test

### Oil Refineries

The Commerce Oil Company owns 80 acres of land on Jamestown's North End. Recently, Commerce Oil has applied for a zoning permit to build a large refinery on this land.

1) List all the good things which bringing in the refinery would do.

2) List all the bad things which bringing in the refinery would do.

3) Select from the following information three items which are more valuable and three which are less valuable.

| | More Valuable | Less Valuable |
|---|---|---|
| a) That there are not enough refineries in the U.S. to meet the oil needs. | | |
| b) That a pumping dock will have to be maintained at the shoreline. | | |
| c) That a deep channel will have to be dredged to let tankers come up to the pumping dock. | | |

d) That most of the 300 jobs created by the refinery will not be filled by Jamestown residents.
e) That the refinery will produce about equal amounts of gasoline and heating oil.
f) That the current population of Jamestown is 2,911 people.

4) List any other things not included in Question 3 that you would like to know before you formed an opinion about the refinery.

5) Several sources of information are listed below. Decide which sources might give information about the refinery and indicate what their views might be.
If the source would probably be for building refineries, write F in the blank beside it.
If the source would probably be against it, write A.
If the source might take a moderate stand, write M.
If the source would supply little information, make no mark.

a) Local office of Department of Health
b) Ecology action group
c) Chamber of Commerce
d) Department of Natural Resources
e) Coastal Resources Management Council
f) Town Manager
g) Narragansett Electrical Company
h) Residents' association
i) Federal Power Commission
j) Better Business Bureau
k) Taxpayers' Association
l) State Airport Administration

6) List other information not included in Question 5 which you feel is also important. Tell how or where you would get this information.

Our program, activities, and teaching strategies all focus on helping students learn knowledge, skills, and attitudes which will prepare them as future voters. We feel we are combining the best of science and inquiry processes with science-related social issues. The end result is a course which students like, teachers enjoy teaching, and which gives students a thorough grounding in applying science knowledge to solve real world problems. Society can only benefit from such a course and the attitudes it helps develop.

# Chapter 10: BIOLOGY AND HEALTH SCIENCE CLASS

By

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The 134-acre Texas Medical Center has 28 institutions housed in 15 separate buildings, including the buildings of the Baylor College of Medicine (BCM) and affiliated institutions. A faculty of slightly over 3,000 serves the institutions within the Texas Medical Center. There are approximately 16,500 full and part-time personnel employed within the Center and a student population of nearly 4,300. There are 3,651 adult, children and bassinet beds within the hospitals in the Texas Medical Center. In addition to these, there are 1,665 beds in the Veterans Administration Hospital and the Jefferson Davis Hospital, also affiliated with Baylor College of Medicine, located near the Texas Medical Center.

The High School for Health Professions is a preprofessional career oriented school which provides in addition to a regular secondary education, a health career directed curriculum and opportunities for developing medically orientated skills under the guidance of the medical community.

Our 779 students in grades 9 through 12 have 52 teachers in a relatively new building. We use four academic laboratories and 15 health science labs. The High School for Health Professions (HSHP) was created through the cooperative efforts of the Houston Independent School District and the Baylor College of Medicine. Students attending HSHP are scheduled into a four year Health Science Training Program. During this training period each student will meet all academic requirements as set forth by the Texas Education Agency and the Houston Independent School District. The singular exception will be Physical Education which has been waived by the state office for 10th, 11th and 12th grade students. The school offers electives in Foreign Language, Advanced Math and Science courses, and Business Education. All students are required to participate in a Health Science course during their Freshman, Sophomore, Junior and Senior years.

The need for a school specifically designed as this one was determined by a needs assessment study provided by the Southwest Center for Urban Research and the Houston Independent School District's own assessment of district students. The development process included:

- An assessment
- A proposal written by Baylor College of Medicine
- Identifying staff
- Course outlines written under the guidance of Baylor College of Medicine;
- Student selection

- Developing a program of classes
- Developing a schedule of classes
- Identifying laboratory spaces and purchasing equipmen
- Starting classes on October 2, 1972.

As a former Secondary Science Consultant (supervisor), I was able to provide some built-in supervision in the development of this program.

## GOALS

The broad general goals for our students include:

- Developing health care skills
- Having a career in some health field
- Furthering their career by attending a two or four year college.

We try to provide a career ladder whereby students may gain medical experiences in high school and, through continuing education, improve their skill and competency toward a professional goal. Students may choose to enter the Junior College for an associate degree or may wish to enter the work world immediately after high school with entry level skills applicable to medical fields. They should be employable with skills and able to enter the work world at anytime it becomes necessary.

In October 1972 the High School for Health Professions opened with 45 sophomores, an acting principal, a patient care technologist, an English teacher, a secretary, an associate professor of biochemistry (part time), and a three-member advisory panel consisting of Baylor's directors of physical medicine, community medicine, and Institute for Health Services Research.

The teachers who were to teach in this program were certified medical personnel. They were experts in their field, but had to learn to teach high school students. This did not prove to be a significant problem. We felt academic teachers must be good but flexible with the student's time. A change often was necessary in these teachers' philosophy of the purpose of education.

Classes met wherever BCM had rooms available and teachers developed courses by meshing college and high school materials and subject matter. Observation, lecturers from throughout the Texas Medical Center, and the very fact of being part of a medical center were important adjuncts during the first year--and made the next natural step hands-on practice.

Over the last eight years the nation's first high school for the health professions has evolved into an outstanding example of the effectiveness of blending academic and experiential education to serve students and community. HSHP has sent almost 90 percent of its students on to college (more than half planning to pursue doctoral studies), had 10 percent of its graduates recognized by National Merit Scholarships, helped approximately 40 percent earn scholarships worth some $800,000, won district attendance awards and numerous local and national academic and vocational competitions, and provided health services and care worth hundreds of thousands of dollars.

Last fall HSHP's 600 students moved into a new $6.4 million building, a symbol of the sponsors' and the city's approval of the school's program.

## OUR PROGRAM

### A Career Ladder Approach

One reason for HSHP's success has been the willingness of the college's medical staff and the high school's faculty to take risks, to experiment with giving high school students academically challenging material and personally challenging health care responsibilities. Adaptation, innovation, and common sense have characterized the efforts as the high school gradually has broadened its academic and experiential components to the point where students begin--and in some cases complete--preparation for almost all of the 200 allied health professions. While students now may learn skills as diverse as measuring air pollution or using word processors, the emphasis remains on patient care, laboratory technology, and advanced science courses.

At the first rung on the ladder, in the sophomore year, all students take two pre-employment laboratory courses. Introduction to Health Science, which prepares students to work on the nursing assistant level, includes nutrition, mental health, drug abuse, the effect of various diseases on the body, anatomy, and nursing assistant skills, such as taking vital signs and making beds. Health Careers includes investigating more than 100 health professions, many of them through on-site visits to the Texas Medical Center.

In the junior year students begin to explore the occupations that interest them by working in related areas. Each quarter a student chooses a class in one of five areas: patient care, medical laboratory, public health and environment, medical office education, and dental assistance. Except in the 12-week medical laboratory sequence, students spend three and a half hours a day the first six weeks of each quarter on academic work and skill development at the school. The next five and a half weeks students work in a health care or public health facility about two and a half hours four days a week and spend the fifth session in the classroom. In addition to the classroom and laboratory teaching of health science the students is assigned to hospitals and clinics for actual patient care contact. While in the hospitals and clinics the students are given the opportunity to rotate through various allied health departments. This rotation enables the student to determine more concretely his career choice. The course in public health is coordinated essentially in the same manner as that with students in the hospitals. The students are given the opportunity to rotate through areas of the public health facilities; air pollution, water pollution, vital statistics, well baby clinics, immunization and public health education, just to name a few. Laboratory skills is designed to give the student skills in bench work of a hospital or health care facility. The student learns skills of measurement, some hematology, enzyme study, urinalysis, and the proper use of many instruments.

In the senior year the students may choose advanced science courses or a career-related co-op program in which they will work at least 15 hours a week for minimum wages or higher and meet with the co-op coordinator once a week. There are five areas of cooperative training; a nursing facility, a public health facility, a medical laboratory facility, a dental facility, or a medical office facility. Students may remain in one work setting all year or change at the end of a quarter.

By graduation students have considerable work experience. Some, particularly dental assistance and office workers, will go directly into full-time jobs. Most will use their occupational skills to obtain part-time employment while they continue to work their way up the educational and career ladders. In doing this they complete a sequence of health-related courses:

Sophomore Level:
  Introduction to Health Science
  Health Careers

Junior Level:
  Patient Care Practicum
  Public Health
  Medical Laboratory Skills

Senior Level:
  Health Occupations Cooperative Training
  Advanced Health Science

The High School for Health Professions is geared to help students make informed decision about their futures. Few people understand the broad range of opportunities and services provided in health professions, i.e. pathology, sanitation, veterinary services, well-baby clinics, and others. Before going into the community, his students are armed with the necessary skills and background to make career decisions and to help them achieve their career goals. They have the basic background to enter college--and 90 percent do-- or to enter the working world immediately following high school graduation.

## Objectives

We want students:

* To have opportunities to become familiar with the types of health care workers and medical facilities;

* To have entry level skills that will allow him to work in a medical facility;

* To have information about community health care workers and medical facilities;

* To have an alternative to the conventional high school curriculum;

* To complete regular academic courses such as science, mathematics, English, foreign language and history to medical concept.

The curriculum is arduous academically, physically and emotionally. Yet, few students fail or misbehave or change their minds and return to their zone schools. One reason for this is the careful screening of students, who are recruited by faculty and students at junior highs throughout the city. To be selected for the school, students must have at least a C average, good conduct and attendance records, good health, and an interest in a health career. Students write one-page statements entitled "Why I Wish To Attend the High School for the Health Professions" and go through a series of interviews with an admissions committee. Students sign a contract pledging attendance, cooperation, completion of work, and care for property and supplies. A parent or guardian must sign the contract, promising to support the student's effort. Such care in selection leads to a most promising and interesting student body.

The student population reflects the racial and ethnic background of Houston, though blacks (at about 45 percent) are above and whites (at about 32 percent) are below their ratios in the city. Hispanics (at about 23 percent) are very close to the city norm. Girls outnumber boys about two to one. HSHP has no records indicating economic level, but administrators nd faculty both estimate that the students come from the full economic range.

Most students enroll at HSHP because they want to become doctors, particularly pediatricians, the specialists most familiar to them. Some abandon the idea of medical school in the sophomore year when they face examinations on college-level anatomy. A few leave the school after their first look at cadavers. Most work hard, re-evaluate their goals, reassess their capabilities, and choose the health care career suited to their capabilities and personalities.

In addition to a strong academic program, the curriculum includes classes in laboratory skills, public health, and late in the junior year, a course in patient care, enabling students to gain practical experience in hospitals, clinics and health facilities. In the senior year, students have the option of working afternoons for monetary compensation.

For most students the critical time seems to be the junior year when they have their first genuine work experience as volunteers in hospitals, clinics, and the public health department. Some of the most dramatic moments come as part of the Patient Care Practicum (PCP), which is no longer required but is chosen by most students. They mature quickly. They have to, particularly the ones who are involved with severely ill patients, those who die. Working in a hospital is the true test for students. Either you can tolerate illness or death or complaints or pressure or you can't.

To prepare students to go into hospitals and function as staff members, students study anatomy, physiology, medical terminology, basic health, and interpersonal relations--and cover ethics, legal issues, the metric system, values clarification, basic safety (on which students must pass a test before going into a hospital), and communications in a medical setting. Skills such as taking vital signs, bedmaking, bed baths, feeding, ambulating, turning and positioning, and collection of specimens are critical.

During the students' time at a hospital they are to satisfactorily perform at least once 16 different basic skills, including checking vital signs (e.g. pulse, temperature, blood pressure), giving catheter care, relating information on a patient's condition or change in condition to the nurse in charge, assisting in pre-operative preparation of patients, and transferring of patients from the bed to a chair or stretcher. Supervisors sign off on these and make an effort to make sure that the students has the opportunity to use each skill that is needed in the unit. Bowen visits students every day to check work, give encouragement, and maintain contact with supervisors.

Even basic skills practiced many times on the school's mannequins test students' poise and self-confidence. For example, one student who was asked to help turn a patient reached down to grasp a leg and found nothing there.

For the most part, patients like the students, though often the sick person is not aware the person providing care is a high school student. Often the students spend more time with the patients because the students generally have more time than the rest of the staff. Students find good use for the listening skills that they practiced in class.

### The Co-op Program

In the senior year about half of the students choose to take part in the co-op program. Students must be in a job within two weeks after school starts or return to their zone school, so coordinators have to begin placement proceedings in the spring or summer. Coordinators and sponsors sign a Cooperative Education Training Plan that specifies such matters as wage, probation, termination, and what students should be learning at the agency in conjunction with their coursework.

One of the programs added in recent years prepares students to become dental assistants. Like students in other specialities, the dental assitants participate in various community service activities. Students go out and teach first graders how to brush their teeth. They do a follow-up with that same class two or three times a year so that we can see how the pupils have progressed.

In addition to the thousands of hours of free and paid work that the students contribute to their community during their junior and senior years, the entire student body takes part in numerous short-term efforts, such as March of Dimes fundraising campaigns, free public screening for such health problems as hypertension, and immunization programs. Students also have worked on crisis hotlines and in such summer-long volunteer programs as Amigos de las Americas.

These students often become informal referral units for family and friends with various health problems. They also may give emergency first aid if, for example, someone in the neighborhood supermarket collapses and needs cardiopulmonary resuscitation.

As for coordinating with the community, last year 200 Health Profession students were certified in the Cardio Pulmonary Resuscitation Program by the Junior League and the American Heart Association. And at the beginning of each school year, senior students undertake a program at Baylor College of Medicine's Department of Biomedical Instruction. They have participated in immunology research and regularly make blood donations. Asked how professionals react to high school students being involved in their research labs and clinical settings, Weston says the students are cautious. They understand the special opportunities extended to them and feel privileged. Their behavior is completely different from that which might be expected, and they are welcomed by the professionals.

One of the developers of the idea for the high school was Dr. Robert Roush, Director of the Center for Allied Health Professions, Baylor College of Medicine. He cautions those who would initiate similar programs, "It takes the cooperation of the local school and the health related community. You need a tertiary care medical center so that students can see the widest variety of health professions. You do not necessarily need a building for the school, but you do require collaboration between the school district and the medical community, particularly the medical school and the medical societies because the school uses so many of their people as lecturers.

While in the 10th grade, a student will receive regular academic instructions in science, social science, mathematics, English, and foreign language. The students also will receive laboratory instructions in the theory and practice of basic patient care as well as being introduced to the working world through instructions in health careers via speakers and tours in medical facilities. In the 11th grade, medical laboratory skills are developed. Additionally, students work voluntarily in hospitals and public health facilities utilizing the skills developed during the sophomore year for more exposure and refinement in the real world of work setting. Health Occupations Cooperative Training is available to students in the twelfth grade at which time students receive credit and monetary compensation for actual work in a health facility. All students who graduate should be able to work in a health facility on the aide or assistant level.

Senior students are presently working in the Health Occupations Cooperative Training program in the following areas: Public Health, Medical Laboratory, Dental Assisting, and Medical Office Education. The sequence of instruction begins with a broad general history and the ethics of medicine. It progresses through skill training of more specific tasks such as hematology, parasitology and microbiology. The broad base triangle is followed toward the top of more specific skills. Students remain in the laboratories until they are able to complete their work and teachers have completed their instructions. Students have a seventh period option which allows them to take more subjects and gain more credits.

## HEALTH SCIENCE COURSE DESCRIPTIONS

### HEALTH CAREERS

This course is a one year pre-employment laboratory required of all sophomore students. It is designed to introduce the student to as many health care fields as possible and to what the careers have to offer. The course utilizes a variety of speakers and tours to the Texas Medical Center. The course also introduces health to the students to help them understand how health relates to them and the community. The course will deal with sickness and wellness with the development of skills as a health care aide.

### PATIENT CARE PRACTICUM

In depth studies in caring for patients in a variety of patient and health care worker relationships are the focus of this course. Skills and proper medical attention to those who are bedridden and/or ambulatory are developed. Skills and theory learned in the sophomore year enhance those learned in this course. Students will be assigned to one of the hospitals or clinics to work on a volunteer basis on the aide level so as to be exposed to health care and to gain experiences of being on a health care team. This on-the-job experience enables the student to make a better decision about his or her future career. Through varied experiences in the clinical setting the student will refine health care skills through actual patient care.

## MEDICAL LABORATORY SKILLS

Laboratory skills is ajunior course of study pertaining to basic medical laboratory techniques and the fundamental scientific concepts upon which these techniques are based. Laboratory investigations in basic laboratory techniques in hematology, clinical chemistry, bacteriology, parasitology, enzyme studies and urinalysis make up the core of the course. Additional work is done in the essential techniques of measurement and the uses of devices such as the analytical balance, pipets, colorimeters, pH meters, and microscopes.

## PUBLIC AND ENVIRONMENTAL HEALTH

This course is designed to provide students with pre-employment laboratory skills, knowledge and scientific health principles, and practices necessary in the prevention, control and management of public environmental factors that may influence man's physical and mental health. Within this course students will function in a real environmental public health facility and be involved in many phases of public health.

## DENTAL ASSISTING

This is a course designed to develop students in basic dental science and clerical procedures. Dental assisting provides skilled assistance to the dentist in three main areas: at the chairside, in taking and processing dental x-rays, and in the dental laboratory. At the chairside the student learns to mix restorative material and dental cements, to pass instruments and materials to the dentist, to make models of the teeth, and to cast inlays and crowns.

## MEDICAL ASSISTING

The medical assisting program provides the student with skills in personal hygiene, medical terminology, vital signs, medical emergencies and first aid, diagnostic procedures, nutrition, medication and patient rehabilitation. These skills, along with basic anatomy and physiology, develop the student into a degree of proficiency that he of she will continue in a nursing type of career.

## ADVANCED HEALTH SCIENCE

Advanced Health Science is a program open to senior students who have completed the junior health science courses and who have had extensive experience and skills in hospitals and clinics. The course deals with the normal function and structure of the human organs and tissues as they relate to the pathology and the pathological skills needed in histologic and in microbiology techniques. The students will identify, cut and mount tissue in histology and in microbiology the student will isolate, identify, mount and incubate microbes for examination.

## LICENSED VOCATIONAL NURSING

The student learns to provide direct personal care for patients take and record temperature, pulse, blood pressure and learn to give medication and treatment. Observing the patient for symptoms or signs of progress is practiced. The student learns to help with bathing and feeding patients and providing other bedside care. This program includes classroom study and supervised clinical experience. Classroom studies include anatomy and physiology plus other related subjects. The supervised clinical practice teaches the student nursing procedures by actual practice in a hospital.

## OFFICE EDUCATION - MEDICAL

Medical Office Education is a pre-laboratory and co-op program designed to prepare the student in communication skills, the office medical procedures and the unique filing systems of hospitals and clinics. Clerical practices used in admission and discharge of patients in addition to the many forms used by each health care field develop the student's entry level skills. The entry level skills enable students to join the co-op program where they are able to accept employment in a health care facility.

## HEALTH OCCUPATIONS COOPERATIVE TRAINING

The Health Occupations Cooperative Training is available to students in their senior year and is designed to place competent students in employment that relates to their individual interests and training received during their freshman, sophomore and junior years at HSHP. Three areas are available: Dental Assisting Co-op, Office Education Medical Co-op and a general area of Health Occupations Co-op. The general area includes students who may prefer nursing, research, docotrs' offices, veterinary clinics or public health.

## FLOW CHART OF HEALTH SCIENCE COURSES BY GRADE LEVEL

Where do I go from here and what are my choices?

### 9th Grade

One Period

Health Science Orientation

### 10th Grade

Two Periods

Health Careers
Introduction to Health Science

### 11th Grade

Three Periods

Dental Careers
Medical Office Education
Patient Care Practicum
Public Health
Medical Lab Skills
Medical Assisting

### 12th Grade

Three Periods

Dental Co-op
Medical Office Education Co-op
Advanced Physiology
Histology
Microbiology
HOCT Nursing Education Co-op
HOCT Public Health Co-op
HOCT Medical Lab Co-op
Licensed Vocational Nursing

This school's primary goal is to make students aware of the many alternatives available to them in the health care spectrum. We do this by a health careers courses, speakers, field trips, and internship experience in hospitals and clinics rotating through various departments. It is necessary to teach value skills and medical ethics prior to the start of the internship program. The privacy and rights of patients must be understood and not violated.

Veneral disease, drug abuse, child abuse, rape prevention, blood drives, CPR, physical fitness, heart-blood vessel risk factors, nutrition, and many others are written into the curriculum in various ways throughout the year. Science-related social problems and issues fit well in the health science curriculum. Pregnancy and teenage pregnancy issues are also taught since we rotate many of our students in OB-GYN clinics.

Decision making is a vital part of student responsibility not only involving scientific knowledge in social contexts, but in the application of health science at all levels. Death and dying, genetic engineering, euthanasia and abortion are dealt with in order to provide the knowledge necessary to function as a health care professional. However, teachers are careful not to force their attitudes and values on the students.

Health Care is culturally, as well as scientifically, valid not only as a career, but because it creates useful persons who can contribute to their community and society. These are life skills. Skills such as CPR and first aid are not skills possessed by the ordinary citizen. These health science skills, by their very nature, are community related. Students hold blood pressure screening tests, assist in sickle cell tests and screening, have blood drives, and sponsor health related programs in junior highs and elementary schools. They also conduct and assist in district wide health fairs. Students have worked to promote such unofficial health care institutions as the American Cancer Society, the American Heart Association and the Red Cross.

The administering of health care to the sick requires that students receive information in the context of himself as an organism in a cultural and social environment. The information given must be accurate and the skills acquired proficient. Mistakes are costly, and students are constantly reminded of their responsibility.

Team efforts are necessary tools of the health care facilities where these students do internships. Interning students are required to become a part of the team or teams in hospitals and clinics. From this experience, they will know and understand the logic behind team efforts. The following daily activities may occur:

- Students moving by time periods from class to class
- Students, in white coats, catching the Texas Medical Bus enroute to the sites of their internships in hospitals and clinics;
- Students in regular academic classes
- Students in health science laboratory classes-- Nineth grade for one hour, 10th grade two hours, 11th grade three hours, and students in 12th grade spend either three hours in labs or at their coop site;
- Students using the Learning Resource Center to prepare an interdisciplinary term paper;
- Students involved in gymnastics
- Students doing special projecst like visiting the water treatment plant;
- Students listening to a guest speakers
- Students having library orientation at the Texas Academy of Science Library in the Texas Medical Center.

## EVALUATION

Student evaluation is based on the ability of students to demonstrate their competencies in the use of skills and information taught in both academic and medical subjects. Students have maintained an average daily attendence of 96.4 percent for the last ten years. In spite of broad student backgrounds, high scholarship is maintained. In spite of having their school day in a work study mode, they are able to maintain good academic standing. We have graduated a total of 1,065 students who have received 1,325,683 dollars in scholarships. The best evaluation has been the amount of press we have received since our existence. We receive a completed evaluation from each hospital or clinic for each student involved in internship or work study training. We are evaluated yearly by the State Department of Education. Staff members of our Advisory Committee at Baylor College of Medicine also evaluate the program. Students are evaluated basically by examinations. Also, written evaluation instruments received from the internship supervisors at the hospitals and clinics are included in student evaluations. A longitudinal study has begun of past graduates. Even though we monitor our graduates constantly, we have not done a pure study.

## SUPPORT

The parent/teacher organization of this program is called the Health Education Alliance League and serves to support the program in general. Through objectives, and projects resulting from those objectives, they supervise field trips, and support beautification projects and attendance projects. Our support from BCM is too generous to describe. First class medical equipment is vital to the success of our program. The cost per pupil is $2,700 to $3,100. The program has been evolving for the past ten years. The number of applicants we receive indicates a bright future of expansion. We had 45 students when we began in 1972. Presently our enrollment is 779 students, and we expect enrollment to continue increasing.

## CONCLUDING COMMENTS

We attempt to assist other schools to establish a similar program. This is being done through meetings with staff members from other districts. Educators from other states, and often medical schools from across the country, want to learn about our program. We give them all we can in terms of materials and knowledge. Teachers should be trained more in their subject areas than many teacher education programs require. While methods of how to teach are critical, math teachers should be math majors and science majors should be science majors with proper additional studies in communication skills and teaching. Too often, math majors minor in English or social studies and don't know enough science to be able to teach well. Education needs to be directed toward something productive. This country and its technology is directed toward high level education and competencies before being employed. Education for education's sake is fine for individuals who do not plan to be productive. The Second Mile Plan of the Houston Independent School District rewards teachers who are productive toward the goals of the district. Teachers are not accepted for a teaching position unless it is felt they can be productive in this program. Qualifications alone are not the only tools the new teacher needs. The principal makes an attempt to participate in classroom activity often in order to better understand what is going on in the teaching process and what he can do to be supportive. Teachers receive money for good attendance and good student scores on standardized tests. Teacher education workshops have not been directed toward helping us. It is my belief that we have done more to help others. I want to thank Dr. Michael E. Debakey and Dr. William T. Butler for their good will and support, Dr. Robert E. Roush for his constant advice and support and Dr. J. Daviod Holcomb for his support.

# Chapter 11: HUMAN ECOLOGY

By

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The Brandywine School District is in the northern section of New Castle County, the northern-most of Delaware's three counties. Although the smallest county in area it is the largest in population with over 400,000 people. Its residents represent a wide variety of ethnic, cultural, and racial backgrounds. As a generalization, high to middle income families live in the suburbs and low to middle income families live in the city of Wilmington, the largest political entity in the county.

In 1978, a dramatic change occurred in the organization and structure of the public schools in northern New Castle County. By order of the U.S. District Court eleven school districts, including the city of Wilmington, were merged into a single school system, the New Castle County School District. In addition, the order called for busing students from the predominantly black populated schools of the city of Wilmington to the predominantly white populated schools in the suburban school districts for nine years and the students from those districts into the city of Wilmington for three years. With this history, we began Human Ecology at Brandywine High School in September, 1980. The program was instituted at Concord High School in September, 1982.

## OUR BEGINNINGS

Brandywine High School, "A United States Model School," with 1,100 students in grades 9 through 12, has a mood of peacefulness and knowing. Our 70 teachers are in a 25 year old building which includes an animal room, greenhouse, hydroponics room, and facilities for independent study. Concord High School is just a little larger with 10 more teachers. This 12 year old building seems more stimulating and active. It also includes an animal room, greenhouse, hydroponics room, and more facilities for independent study.

Jack Carney, after 25 years of delivering pupil services (counseling, health, psychological, social, speech, hearing and special education services) felt an urgent need to develop a program addressing the prevention of human problems. As ecology relates to our natural resources, the Human Ecology Program relates to the conservation, preservation and development of the most important resources on earth, our human resources. The prevention of birth defects as well as the prevention of mental and emotional handicaps are included as units of study in the physical and psychological development of the human. Jack conceived the term "Human Ecology" because he thought an ecology related to humans was needed in light of the multitude of human problems and the attention given to ecology related to the physical environment.

Following a presentation of the program by the originator in the spring of 1979, the New Castle County School District's Curriculum Council (representative of all four area schools) approved the Human Ecology Curriculum model for possible introduction in the schools. In the fall of 1979, an Ad Hoc Committee of the Area I schools of the New Castle County School District including a representative of Central office curriculum administration, the Brandywine High School principal and four of his interested teachers and the originator met to begin developing a curriculum program in Human Ecology. After a review of the rationale, general goals and objectives, and suggested components they went ahead. The principal and his interested staff responded positively to the introduction of a Human Ecology curriculum program at Brandywine High School as a pilot program.

Dr. Frank J. Furgele, Superintendent of schools, made a vital commitment by approval of the basic concept, model, and in-service training for the development of the program. In addition, he has committed one teacher unit to the program each school year since its inception. Dr. Peter Bachmann, former Supervisor for the Delaware State Department of Public Instruction, enthusiastically supported the program model by providing $1,000 in federal funds for the support of the In-Service Program. Some external input came from "Priority One: Environmental Program," an exemplary program approved by the Joint Dissemination Panel of the National Diffusion Network Division of the U.S. Department of Education. Also, the State Supervisor of Human Relations made possible the procurement of federal funds to support teacher summer curriculum development workshops for three years at approximately $3,500 for each workshop.

The originator and the teachers planned and wrote the curriculum program including the teacher and student curriculum handbooks during those workshops held during the school year and for periods of two or three weeks during the summers of 1980, 1981 and 1982.

## OUR GOALS

The Human Ecology Program was introduced into the curriculum of the Brandywine School District as an innovative science elective course at Brandywine High School in September, 1980. The central focus of the Human Ecology Program is the development of the human and the well being of individuals and families in their social and physical environments. The program includes a study of the physical and psychological development of the human, the influence of social institutions, family, church and the effect of the physical environment on the development of the human. The overall goal of the program is to provide an opportunity for students to become active in the advancement of the human condition through the acquisition of knowledge, skills, and attitudes that will improve effectiveness in dealing with their environments.

Students are to:

* Develop an appreciation for the beauty of knowing vs. not knowing.

* See the history of scientific discovery in

relation to the career-efforts of living personalities.

- Recognize the value of scientific research in relation to making peoples lives more productive.
- Know that the study of science is fun, profitable, and mind-expanding.
- Feel that scientific knowledge belongs in the mind, and not just in the lab.

We hope students will:

- Acquire habits and attitudes necessary for responsible citizenship;
- Acquire the elements necessary to understand physical and emotional well being;
- Develop a conern for moral, ethical, and spiritual values
- Develop an appreciation for one's worth as a member of society
- Develop an appreciation of the family.

In working toward these goals students study the population explosion; energy alternatives, including solar and nuclear energy; and land use management.

Students use role-plays (energy, population selection) and formulate their own attitudes and ideas by gaining insight into the attitudes and ideas of other people. One role play, "Congressional Hearing: The Energy Crisis," enables students to apply scientific knowledge in answering questions within an institutional social context. It emphasizes critical thinking activities in units on values clarification, stress, and environmental pollution.

Career awareness is an integral part of the Community Service component of the Human Ecology Program. Students volunteer a minimum of twenty hours working with a professional staff member in one of fifty state and local community agencies. During this experience, students are able to develop an awareness of a variety of careers and assimilate specific information about them. This process assists students in future career choices. Students are able to assess their interests, aptitudes, and skills as related to helping other human beings. Value, ethical, and moral considerations of science-related issues are important as students become aware of the values and attitudes of peers. They also come to develop a rationale for use of drugs and alcohol, and become aware of ways in which individuals may be helped through application of scientific studies.

The rationale for human ecology implies students will identify, plan, develop, and implement solutions to community-related problems. One student's project involved a "Kerosene Heater Survey on User Abuse." In the program, students learn how the influence of local and community resources is used in helping to solve human welfare problems.

The program exposes students to the vast mechanisms society has developed to deal with the effects of human suffering and seeks to help students understand how to avoid or change negative behaviors. Students study the influence of social institutions, marriage, family and religion in the development of the human. Students are provided opportunities in this course of study to relate the influence of these social institutions, particularly the family and religion, on their own development. Since the entire program focuses on the development of the individual and the family in their immediate physical and social environment, the program also encourages students to find solutions to problems of human welfare. Thus, the teacher must evidence a commitment to human welfare and the growth of mankind in society.

The following curricular areas are especially pertinent to the course.

1. The patterns of reproductive and child-rearing practices that reduce the probability of future physical and mental handicaps, e.g., influence of substance abuse, infection and nutrition on the growth of the fetus and the importance of sound child care during the early stages of human development.

2. The elements necessary for or detrimental to the psychological health of human beings e.g. psychological and physiological characteristics of stress and the coping skills to mediate stress; causes and prevention of teen age suicide.

3. The physical factors in the natural environment (water and air pollution, land usage, and energy) that interfere with the optional growth and development of human beings. Specific problem areas covered are: population growth, solar and nuclear energy and environmental pollution.

4. The factors responsible for the development of healthy individuals and families according to recognized authorities, e.g. stages of human development, factors important in the selection of a marriage partner, roles and functions of a family etc.

5. The development of positive human relationships, the ways of improving effective human relations skills, and the benefits derived from practicing effective human relation skills.

In this program, students learn, teachers teach, and the curriculum is prepared by teachers. It is a traditional approach to evaluation and management. While it is traditional, the students' primary role is to be a "critical listener" and "inquisitor." And, in visiting the classroom, one would see students "involved" in the accomplishment of the instructional objectives by using an inquiry approach.

## TEACHING APPROACH

In general, visitors see students: listening and discussing a given topic; individuals or groups of students giving oral reports to the class; viewing and discussing an audio-visual presentation of a curriculum topic; engaging in a community service volunteer activity with a human service agency. Cooperative work in class is used about 20% of the time.

Teaching strategies include active inquiry as a major learning mechanism and teaching for mastery versus content coverage. Effective use of audiovisual materials is critical and the learning environment is directed through continuous reference to the achievement of the program objectives. In a somewhat traditional approach teachers introduce ideas (but in a variety of ways), lead discussions, make presentations, and evaluate student progress. Teachers do vary their style and avoid being boring or teaching too much content. They tend to stress the use of knowledge while maintaining the pragmatism of a working scientist. An essential component in the philosophy is that teachers must avoid talking too much as it inhibits student response.

A multi-faceted model of instruction is used to maintain interest and motivation of the students. A team teaching approach is used on a limited basis and guest instructors from various disciplines and places of employment enrich the program. Current audiovisual instructional materials on various topics of course content are used in the classroom. The Community Service component of the program is an item of high interest as students volunteer a minimum of 25 hours working in a hospital, nursing home, or other agency.

Teachers are given an opportunity to teach subject matter and related issues which are of compelling significance in our society. From this, they gain a feeling of satisfaction that the teacher's instruction of the subject matter will help to prevent some of the human problems students experience now and in the future. All teachers involved in the program to date have written curriculum, assisted in determining the evaluation design, selected laboratory materials, and have taken part in the instructional process in some way. The writing team made the program transportable, so that teachers who adopt this program in the future can assume the role easily.

## COMMUNITY BASED CURRICULUM

The teacher-developed curriculum and student handbooks are community based. They also developed video tapes of classroom instruction by experts in science and social service fields; leading to a library of current casette/tapes on specific curriculum topics such as the Prevention and Causes of Teenage Suicide. The basic written instructional materials for the program are the Teacher Curriculum Handbook and the Student Curriculum Handbook developed by the involved staff in two summer teacher workshops. They also use the textbook, "The American Family: Life-Styles in a Changing Society," as a supplemental textbook during presentation of the Social Institutions component of the program. **Priority One Environmental Materials** from Union Township, New Jersey, supplement the Human Ecology Student Curriculum Handbook during the presentation of the Physical Environment component of the program. This program has been nationally validated by the U.S. Office of Education. Twenty modern filmstrips/casette tapes on a variety of curriculum related topics e.g. "Dealing with Stress," "The Good Marriage," "Suicide: Causes and Prevention," "Today's Family: A Changing Concept," "Genetics: How Life Remakes Life," "Preparation for Parenthood," "Do I Want to be a Parent? Now? Ever?" are used as well. These audiovisual materials are published by SUNBURST COMMUNICATIONS, Pleasantville, N.Y. Video equipment has been borrowed and used to develop tapes of guest lecturers, presenting a specific area of expertise and addressing a particular topic in the curriculum.

The Community Service component of the program provides an opportunity for students to demonstrate their sensitivity to the state of the human condition by volunteering their time working in a human service agency in the community. The sequence of instruction begins with a student self-inventory where students attempt to answer the questions, Who am I? and What do I want to be? Then, the student reaches out to his immediate associations in school, his peers. Here students examine and improve their human relations skills.

In the third and fourth sequences, students focus on the physical and psychological development of the human wherein they develop knowledge, skills, attitudes, and insights about the so called norm or average developmental bench marks for the major stages of development. Students then relate them to their own development. Prevention of physical and emotional handicaps is emphasized.

In the fifth sequence, students study the influence of social institutions, marriage, family, and religion on human development and self-development. In the sixth sequence, students learn about the influence of the physical environment on the development of humans, e.g. air and water pollution, land usage, and energy usage. Lastly, the student reaches out to help neighbors through volunteer service in a human service community agency. Within a seven day cycle, Human Ecology meets six of seven days in a 52 minute period. It is an 18 week semester course.

## CURRICULUM HANDBOOK FOR TEACHERS

## TABLE OF CONTENTS

I. Introduction

Rationale/Goals 2 days
Historical Development

II. Self-Inventory

Who Am I? 1 day
What Do I Want To Be? 2 days
What You May Want To Be? 4 days
Human Relations in the School
  What? Why? How? 3 days

III. Physical Development

Passages 2 days
Embryonic Development 2 days
Developmental Handicaps 2 days

Human Genetics 5 days
  Objectives 1-4
  Objectives 5-8
  Objectives 9-12
Human Genetics Evaluations 1 day

IV. Psychological Development

Values Clarification 2 days
Effects of Drugs 1 day
Effects of Alcoholism on the Family 2 days
Motivation 2 days

| | | |
|---|---|---|
| | Abnormal Behavior | 3 days |
| | Abnormal Behavior | 1 day |
| | Suicide | 2 days |
| | Stress | 3 days |
| | Psychology Evaluation | 1 day |
| V. | Social Institutions | |
| | Pretest | |
| | Family Terms and Functions | 1 day |
| | Family Functions | 1 day |
| | Family Tree and Roles | 2 days |
| | Women and Work | 1 day |
| | Family Relationships | 1 day |
| | Marriage | 1 day |
| | Divorce | 1 day |
| | Parent-Child Relationships and Divorce | 1 day |
| | Social Agencies and Institutions | 8 days |
| VI. | Environmental Factors | |
| | Environmental Pollution | 3 days |
| | Population Explosion | 3 days |
| | Energy | 6 days |
| | Land Use | 3 days |
| VII. | Community Service | |
| VIII. | Bibliography | |

## EVALUATION

The program is evaluated directly through instructional objectives stressing the use of knowledge to improve the quality of living. Students are evaluated in a traditional manner with four major tests, a final examination, teacher observations and community service volunteer activity all being used to devise a traditional "A" thru "F" grade. An evaluation form is used by the community agency supervisor to help evaluate the students' community service experience. Pre and post evaluative data is available in terms of results from teacher made tests. The collected data initially indicates that the students are achieving the objectives of the Human Ecology program. Data currently is being collected within the dimensions of a quasi-controlled research design. As part of the district-wide teacher evaluation program, teachers are formally observed every year, and formally observed and evaluated by the principal or assistant principal every other year.

Students of Brandywine High School usually rank first in the state on comparative California Achievement Test scores and rank first in the state in public school National Merit semi-finals. Changing the formal evaluation system for the program to better reflect the instructional outcomes and needs of the program is in progress. The formal evaluation system is being developed by the research and evaluation department of the College of Education, University of Delaware. It is hoped that the planned evaluation system will be useful to all.

## MAINTAINING THE PROGRAM

The school principals of two of the four high schools in the district have approved the inclusion of the program in the curriculum of their school. The principals serve on the program planning committee which also consists of the originator/district coordinator, the in-school teacher coordinator, and other involved teacher personnel. The Superintendent supports the program by assigning a teacher unit to it and the Assistant Superintendent for Curriculum and Instruction has supported the program by her approval of introducing the course into the curriculum of the district. Principals provide support for the program by scheduling time to develop new curricular materials and by providing funds for professional travel. They encourage change and act as educational catalysts. They remember that "Teachers Make It Happen."

The following significant expenses have been mandated in the development phase of the program:

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|---|---|
| - 3 Teacher curriculum/program summer workshops | $9,000 |
| - Instructional audio visual materials | 2,500 |
| - Teacher and Student Curriculum Handbooks | 1,000 |
| | $12,500 |
| Estimated cost per pupil ($12,500 divided by 100 students) | $125.00 |

The originator and district-wide coordinator of the program (part-time) assumes responsibility for pursuit of adjunct financial support of the program from the March of Dimes Birth Defect Foundation, orders new instructional materials, and provides in-service education programs for teaching staff. He also processes most of the communications about the program and coordinates publicity and information dissemination on the program. The in-school coordinator of the program is responsible to the principal for most of the operational aspects of the program such as teaching, implementation of the curriculum guide, and the evaluation component. A central planning committee meets periodically to plan, develop and assess the extent of program progress.

The planning group does not see the program goals changing substantially although they may be more specific in the definition and evaluation of them. A stronger humanities component may be added to the overall program. Community needs are responded to by determining community changes through communications via neighborhood and local newspapers, staff and community leaders, and resident contacts. These community changes are discussed by the program planning committee and in teacher workshops. If agreed, appropriate changes or revisions in course content or activities are incorporated into the program. They also use the NSTA and NABT Journals which are available in the school library. Journals are used in gaining knowledge in curriculum design, new text information, laboratory equipment, and keeping up with "Who's Who" in the profession.

The addition of a Human Ecology Resource Room to house the instructional resource materials, equipment and software is contemplated. It would also provide space for teacher/student individual and small group meetings, and an office with a phone to effect the implementation of a student-community hot line of human services. These services would be requested by persons living in the community and would include, for example, transporting a person to a hospital and custodial care for an elderly individual on a limited time basis. Also in planning is the release of involved teachers on a bi-monthly basis in order to carefully plan, develop and evaluate the on-going program in cooperation with the originator/district coordinator of the program.

The major budget needs over the next few years are funds for Teacher Curriculum Workshops for new teachers in the program, instructional materials, funds for program information dissemination to secondary schools located outside the school district, and funds for the conduct of student workshops on a county or state level which would focus on Human Ecology issues.

The team attempts to enlist more teachers to use the program by conducting program orientation/development meetings with teachers and principals in high schools. Hopefully, the program orientation motivates the participants to recommend the introduction of the Human Ecology Program into the curriculum of their schools. If teachers continue to maintain their personal commitment, interest, and enthusiasm for the program and continue to demonstrate these qualities in their work with the students enrolled in the program, there is no doubt the program will grow and prosper. Changing from a semester course to a full year course and a required course for graduation would really be part of the program's hopes for the future.

As the program changes, it will be enriched by students taking a more active role in planning implementation of new additions to the program. For instance, students can implement a hot line of human services and student oriented Human Ecology Workshops on important human ecology issues.

Program failure can come easily through curtailment of administrative commitment and financial support for the program coupled with a sharp reduction in the commitment and enthusiasm demonstrated by teachers. Eliminating in-service education of involved staff could cause a failure as well. All of these aspects are crucial and necessary for the continued success and effective development of a human ecology program. It functions as a free elective, therefore, the quality must be maintained, or the students will not elect the course.

## TRANSPORTABILITY

The crucial elements in trying to establish the program in a new school are a thorough program orientation of administrators, including high school principal, specialists responsible for curriculum and instruction in the new school, and appropriate teachers. This program orientation can be presented by one or more involved administrators and staff who are part of a successful human ecology program and should include every aspect of the program including rationale, goals, objectives, program components, instructional model, curriculum handbooks overview, bibliography, program evaluation and budget. Sufficient time should be reserved for dialogue and questions about the program elements.

Ideally, a new teacher should have college training in science and behavioral studies such as psychology, sociology, and anthropology. In addition, he should possess effective human relation skills and demonstrate a positive attitude in helping students to change their own behaviors. A new teacher should be able to communicate to students that they can make a contribution to improving the state of the human condition. New teachers must show sensitivity to the nature and extent of human problems and a commitment to teach subject matter which can prevent human problems.

For someone trying to set up the program, it is recommended that new teachers be participants in program orientation meetings with other recommended administrators and teachers in the new school. An absolute requirement in the launching of a new program is the commitment given to the program by the central administration, high school principal, and recommended teaching staff. This commitment must be demonstrated by the administration (central office and principal) in the form of start-up funds for the development of the program. Also, the teacher commitment should be demonstrated by their enthusiasm and willingness to work energetically on program development. Finally, a developing and established program needs a coordinator who will monitor the program on a regular basis.

During the teacher education workshops in 1980 and 1981, the focus was on the planning and development of the entire program including the goals, objectives, curriculum program components, Teacher Curriculum Handbook, evaluation system, a bibliography, and reviewing and recommending for purchase various instructional equipment and materials. Also included were guest presentations given to involved teachers on curriculum related topics. The more recent role of workshops has been revising the Curriculum Teacher Handbook and developing a Student Curriculum Handbook, including a Student Workbook section. In addition, provision was made for the continuing education of involved teachers who benefitted from the presentation of two guest professionals. These speakers were a Genetic Toxicologist from the DuPont Company and a professor of Family Studies at the University of Delaware. Also on a recent agenda was a dialogue and critique of the planned evaluation design which included the involved staff and the developer (University of Delaware researcher) of the evaluation model. The future role of these workshops will include a similar format, especially continuing education of staff on curriculum topics with an in-depth approach. In addition, the workshops will include time segments for the program orientation/development for new teachers within and outside the school district.

## CONCLUDING COMMENTS

It is hoped more colleges and universities will include courses and major studies in Human Ecology like the ones found at Cornell University and the College of the Atlantic in Maine. Like these institutions, it is important that future teachers are educated about the ecology of the human in an interdisciplinary model integrating the disciplines of psychology, sociology, anthropology, environmental studies, and human development.

Dr. Frank J. Furgele and Dr. Louise Maslin, Assistant Superintendent for Curriculum and Instruction as well the Director of Secondary Education, Mr. Jack Vinokur and the principal of Brandywine High school, Mr. Wayne Von Stetten, approved each aspect of the developing Human Ecology Program. These included rationale, definitions, goals, objectives, and major program components.

After the Superintendent contributed a teacher unit to the Human Ecology Program at Brandywine High School, the administration of Brandywine High School, specifically the principal, Mr. Von Stetten, approved inclusion of the Human Ecology Course in the high school curriculum as a one semester elective course for a report card grade and one-half credit. The course includes the student volunteering a minimum of twenty-five hours working in a community service agency.

Teachers involved in establishing the program evidenced keen knowledge of proposed instructional content, experience in teaching many components of the program and a personal commitment to develop the program.

In addition to the cognitive, community service, and classroom instruction phases of the Human Ecology Program, the concept of Human Ecology involves a spirit and a sensitivity that is expressed in the quotation, "Every human encounter is an opportunity for growth." There is no doubt that the course in Human Ecology is needed by students to assist them to function in today's society. There has always been recognition that one must preserve our resources in nature and schools have begun to address that area of need. Very little effort has been expended to implement educational programs which involve the most precious resource--humans.

The Human Ecology program is a unique attempt by a school to provide instruction whereby students will acquire knowledge, skills, and attitudes enabling them to become an active force in the improvement of the human condition. By providing new content material, an expansion of student-adult contacts, modifications in the organization for instruction and a realignment of personnel, the Human Ecology program deals with such critical human problems as teen-age pregnancy and suicide, birth defects, mental illness, family life, treatment and care of the elderly, and concerns for the physical environment. The course brings together the subjects of social studies, science, and the behavioral sciences (in an interdisciplinary model) to give students a comprehensive look at the human condition today and where it appears headed in the future. This approach enables students to understand the relationships between people and the world around them. It enables the students to see how people, society, and nature relate to one another, and how they begin to affect their own well-being as well as the people around them. It teaches the true meaning of the word H.E.L.P. Helping Everyone Live Productively is the bottom line of Human Ecology in the Brandywine School District.

# Chapter 12: EXCELLENCE IN TEACHING BIOLOGY: A CRITIQUE

By

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> What is required is the greater use of the natural environment, community resources, and the students themselves as objects of study.
> Paul DeHart Hurd (Harms and Yager, Page 19)

## A NEED FOR NEW DIRECTIONS

In Chapter One Rodger Bybee pointed out the need for conceptual orientations which would avoid the problems of the past and the future. With these concepts he feels we might then examine the impact of human technology on life forms and the human interventions which cause or may prevent them. In doing so, we must focus on human ecology as a key element in our environment. As we focus on humans and bio-social issues, we come face-to-face with directing our own evolution, or co-evolution as it has been called.

Although bio-social problems affect us daily and most people recognize individuals as part of both the problem and the solution, traditional biology classes rarely go beyond presenting information. This going beyond is what may well make the difference between an optimal future for mankind and a far more bleak scenario.

Although we fully agree that some biological knowledge, processes, skills, and understandings are necessary to be a fully functioning human being, students must learn how values and ethics relate to personal decisions and social policies. Not only should biology education lead to a fundamental understanding of biological systems with students understanding and using methods of science, biology education must prepare citizens to make responsible decisions about science related social issues. As Paul DeHart Hurd has pointed out, "the over-arching rationale of the desired program is a use of biological knowledge to enhance the understanding of one's self and to benefit the quality of life and living for human beings." This is decidedly at variance with the notion of biology classes being primarily for the training of scientists.

Bybee's suggestion of a new focus on human ecology does indeed meet most of the Project Synthesis criteria deemed necessary for excellence in biology teaching (Harms and Yager, 1981). Project Synthesis researchers emphasized four goals for students; 1) scientific enlightenment, 2) career awareness, 3) development of skill in inquiry and decision making, and 4) appreciating biology in the service of society. Human ecology focuses on personal needs and broadens our traditional view to include societal issues in biology. This biology involves ethics, values, morals, and aesthetics. Human ecology emphasizes cooperative learning among groups and has a new orientation toward many and varied careers in biology, health, and the environmental sciences. For the first time we are recognizing that biology as a discipline has not only a history but a future as well.

In human ecology, classrooms have become experiential before being experimental. Children are treated first as curious naturalists, then as informed citizens, and finally as professional biologists in college if their needs and interests are in that direction.

## SOME EXAMPLES

The ten exemplary biology programs described in this monograph mirror many of the qualities, goals, and content suggested in Chapter One. Some are very specific and others are broad survey courses. But, regardless of their success at meeting the Project Synthesis criteria they are all attempting to do something and do it well. In Chapter One Bybee made several suggestions about needed aspects of biology courses which would serve us well in the future. The exemplary biology programs described in this monograph have made remarkable progress toward these futuristic and necessary goals.

**We must go beyond presenting information. Biology teaching must consider values and ethics as related to personal decisions and social policies.**

In Cherry Creek, Colorado, the biology teachers have taken a team approach to teaching biology (Chaper Three). In this team approach they emphasize social problems, issues, and human adaptations for alternative futures. While this is a survey course in biology, humankind is a central focus with values and ethics given considerable attention. And it must be working; the number of students studying biology has increased twenty percent in five years until 90 percent of the students enroll for this elective course. Almost 80 percent of those students go on to study chemistry as well.

Chapter Seven, the Biology I and II program, is another broad survey course designed for students to investigate and experience basic inquiry in science. In these two courses students find much of the science is related to social issues and the history of science with activities drawn from law, religion, and government. Significant portions deal with values, ethics, and decision making.

Students at the Drey Land camp (Chapter Eight) are expected to develop positive attitudes and values about the environment. They do this through an intensive outdoor experience lasting four days and nights. Living and working together is an important part of the experience.

## We need to broaden our view to include social issues.

Without exception, these ten exemplary programs present societal issues in biology as prominent and needed parts of the curriculum. In discussing societal issues students read current newspapers and magazines, do informal opinion surveys, and participate in simulations of real world problems. These students are learning that societal issues do not have right or wrong answers but that suggestions and actions do have logical and natural consequences. Most importantly, students in these programs are learning that these consequences come about because of their own actions, inactions, or knowledge. The Biology I and II program (Chapter Seven) has several major activities where students study problems confronting a traffic engineering problem or issues in genetic engineering.

Human Ecology, Chapter Eleven, not only allows students to study institutions such as marriage, family, and religion, but there students see psychology as an important component of the study of humans. Human development and our role in society is studied using role plays and other non-traditional learning experiences. These students are encouraged to be introspective and to relate themselves to the society about them. In doing so, they are learning to use their knowledge of biology to look at issues which go considerably beyond the normal realm of biology courses.

## Human Ecology must focus on Humans as key elements in our environment.

While the cellular, biochemical or holistic approaches to biology have been well received, many of these exemplary programs have made a serious decision to focus on humans as key elements in the environment. In doing so, they recognize the impact of humans on the environment and our ever-increasing ability to direct our own future and evolution. Students studying biology from a human focus are noticed to be more interested in biology, are finding that biology is relevant to everyday life, and want to enroll in more elective science courses.

Chapter Eleven, the Human Ecology Program, like many traditional programs presents content in an essential role. But, the student role changes so that students become inquisitors studying populations, energy flow, and other aspects of science and biology affecting human development. Students learn to look inward and to consider themselves and their roles now and into the future through career awareness.

Biology and Health Science, Chapter Ten, is a special program for students interested in the health sciences. Here, a whole high school is focusing the entire energy of its students on the health professions. Students have clinical expereinces in a hospital, see first-hand career alternatives in the health professions, and recognize the importance of humans as well as links between humans.

Chapter Six, Stones and Bones, is an anthropology unit for use in biology, general science, or as a semester long course. This problem and inquiry centered program emphases an interdisciplinary approach to the study of adaptation of humans. Students conduct laboratory investigations about humans now as well as in the past and future. Students use the information they obtain in making decisions about how humans came to be as they are, where they are now, and where they might well be in the future.

## We must consider relations between ecology and the community.

Seventh grade students in Ecology and the Community, Chapter Nine, investigate an outdoor site each spring. Then, they study the economics, history, government, town services and other factors of their community. Finally, they draw parallels between their community and the environment. As eighth graders, they teach these concepts to elementary students.

The Limnology Program described in Chapter Four has students collecting lake samples every other day and conducting a full range of chemical and physical tests. These data are then used by a local newspaper in an environmental newsletter to the public. In addition, students do public awareness workshops on water quality. This heavily field and laboratory oriented elective course focuses on local quality problems and the communication of these problems and solutions to the general public. While students learn the usual classical knowledge of limnology, their focus is on man's impact on the water environment. Students are active in the community and community members are active in the program. Part of their success may be measured by the fact that much of the program is grant supported.

In a similar way the Summer Marine Biology Program described in Chapter Five uses many professional members of the community. Students find that these professionals are involved in managing the environment in a variety of ways. While studying in field locations, students focus on pollution and man's impact in the natural environment. Their notion of the community of man expands greatly beyond what they normally would find in a classroom.

At Drey Land, Chapter Eight, students see themselves as part of a community and, while living together for four days and nights, come to understand that community better.

## We need to study biology as a discipline with both a past and a future.

Lindlearn Biology, Chapter Two, is a holistic and interdisciplinary course focusing on the quality of human existence in the future. Although this course follows the New York State Biology Syllabus, it is not lecture-oriented. The well-organized teacher in this exemplary program is in a far less central position than might be expected. The program is self-paced, designed for individuals or small groups, and teachers expect students to take much responsibility for learning. Lessons are preplanned so the students determine the pace, the emphases and the timing of evluations.

Chapters Four and Five, both emphasizing aquatic biology, present a case for man having control over some aspects of the environment, now and in the future. In both these programs students come to learn that most problems in the aquatic environment are a result of human intervention and that only human intervention can solve the problem ultimately.

Stones and Bones in Chapter Six presents most directly the notion that man has a long history and, with some care of the environment, can have an equally long future. All ten of these programs bring students face to face with the notion that there are alternative futures available to them. They see these alternative futures as possibilities, but only if they work to make them happen.

In Biology and Health Science, Chapter Ten, students see first-hand how human intervention can change the future for others. Most of these students have seen a patient die and seen others live as a result of the health care they receive. How much more clearly can students be brought face to face with their own mortality and the inevitability of some future? At the same time, these students are learning that the quality of that future can be modified, controlled and directed.

## SOME RECOMMENDATIONS

Exemplary programs go beyond the classroom in helping students realize that education is part of living and that school is a vital part of the community. Human ecology must focus on humans as key elements in the environment. Now that we are faced with directing our own evolution, we must examine the impact of human technology on life forms and the human interventions which may cause or prevent them. Outstanding biology programs must be designed with a strong awareness that most students will not become scientists, much less professional biologists. With this in mind, we need to offer programs providing information about careers and professions in science areas. Students must see how the knowledge of biology can be used to study and solve current social issues.

We need to have a periodic reformulation of goals for biology education so that our biology programs can continue to be fresh, useful, and enduring. While biology education should lead to a fundamental understanding of biological systems, it should also lead to an equally fundamental understanding of the nature of science and scientists and the development of values and ethics of the environment.

If we can make personal and societal needs a primary orientation in biology education, then laboratories would become a place where confrontations between students and personal and societal problems may take place. Students can begin making decisions and taking actions rather than blindly following paths. Such laboratories perhaps would be more experiential in beginning classes and more experimental in the higher grades. In essence, in the lower grades we should view the child as a curious naturalist whereas in the higher grades we would view students as informed citizens. Only in college biology should we ever consider "professional biologist" as the theme. When we have achieved this we will find that we are now preparing citizens to make responsible decisions about science-related social issues and themselves.

## TEACHERS AND INSTRUCTION

Project Synthesis suggested that teachers in a desired biology program would:

- use discussion
- not force closure
- seek conflicting points of view
- relate biological knowledge to individual problems
- use group problem solving for conflict resolution
- use community resources
- know the concepts and principles of biology, as they relate to personal needs and social issues.

Although the programs described in this monograph require such a teacher, our own experience suggests that few teachers are consistent in these actions. We suspect the teachers themselves need encouragement and help to move in this direction. Until they do, these programs will not be as exemplary as we would like.

## CURRICULUM

While these ten programs have made enormous strides in reaching the Project Synthesis goals, they have not gone far enough. Often they are still tied to a content oriented biology syllabus which emphasizes "covering ground." Only in a few of them are students truly taking responsibility for their own learning. While students may be taking action in making decisions, perhaps they could make more decisions about their own learning and not just about how to apply that learning.

We are very pleased to see units from law, religion, and government in several of these programs and we are equally pleased to find that in most the teacher's role is considerably different from that of a traditional classroom. Still, students are not working in cooperative small groups as much as they might and there still seems to be a heavy emphasis on the history of biology rather than the present and the future.

## EVALUATION

Students must be evaluated on their ability to use knowledge of biology in interpreting and reconciling personal and societal issues. We must determine their ability to make rational decisions and design action plans for applying them to their own environments. Ultimately, we should evaluate the success of our biology programs by determining if graduates do actually take rational action with their biological knowledge.

We are very optimistic. These ten programs show that biology education does not have to be a stale, historical, terminological approach to the study of science but can instead be made exciting, relevant, and appropriate to learners. We have no doubt these ten programs will continue to grow, change, and evolve.

Perhaps now you should reread Chapter One and consider how your own program might take advantage of what these ten have tried. When you insure that your own program is evolving, then we will feel we have truly made a giant step forward in keeping biology education relevant, useful, and interesting to our clients, the students. And, as part of that evolution, biology teaching will become more in harmony with science as an enterprise, the disciplines of biology, and social/cultural shifts in the United States.

## REFERENCES

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